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March 1962

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RADIOLOGICAL HEALTH DATA

QUARTERLY REPORT JANUARY 1962 VOLUME III, NUMBER 1

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service ● Division of Radiological Health

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SECTION I. — AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air due to fallout from nuclear weapons tests. Prior to September 1961, it consisted of 45 stations at urban locations operated by State and local health department personnel with 2 of the stations operated by Public Health Service personnel. Following the Soviet Union's resumption of nuclear weapons testing in the atmosphere during September, the network has been expanded to nearly 60 stations (see Figure 1).

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Air is drawn through a cellulose carbon-loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. Field measurements enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known source using a portable survey meter. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D. C., for a more refined measurement using a thin-window proportional counter. The station located at Atlanta, Georgia, conducts its own laboratory analyses.

Table 1 presents the monthly summary report of fission product gross beta concentrations in surface air during October 1961. Daily laboratory results will no longer be published in *Radiological Health Data* unless a marked increase in levels is again observed.

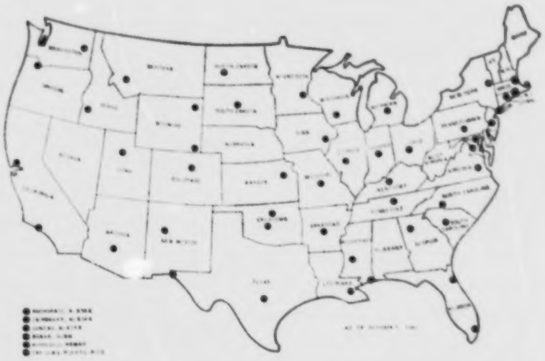

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

4<

ABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR, OCTOBER 1961 GROSS BETA DETERMINATIONS

Station location		Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Average[1] ($\mu\mu c/m^3$)
City	State				
Anchorage	Alaska	31	15	0.54	4.1
Fairbanks	Alaska	30	5.9	0.18	2.9
Juneau	Alaska	31	10	0.23	2.9
Kodiak	Alaska	2	3.2	1.6	2.5
Phoenix	Arizona	30	57	2.5	19
Little Rock	Arkansas	31	15	1.5	7.3
Berkeley	California	30	35	1.5	12
Los Angeles	California	30	19	1.5	9.4
Denver	Colorado	30	30	1.0	8.7
Hartford	Connecticut	30	17	1.6	7.7
Washington	District of Columbia	31	23	2.6	8.9
Jacksonville	Florida	31	49	<0.10	14
Miami	Florida	31	40	<0.10	5.9
Atlanta	Georgia	31	35	2.6	9.8
Honolulu	Hawaii	31	5.2	<0.10	2.0
Boise	Idaho	30	71	1.6	16
Springfield	Illinois	30	19	1.5	8.5
Indianapolis	Indiana	31	27	2.2	8.5
Iowa City	Iowa	31	18	0.63	6.2
Topeka	Kansas	31	23	1.3	8.1
Frankfort	Kentucky	30	39	2.0	8.8
New Orleans	Louisiana	31	26	1.6	7.3
Baltimore	Maryland	31	28	3.0	10
Lawrence	Massachusetts	30	16	0.82	5.1
Lansing	Michigan	31	24	2.3	10
Minneapolis	Minnesota	31	18	0.74	6.1
Jackson	Mississippi	22	18	1.6	6.6
Pascagoula	Mississippi	25	19	2.9	9.1
Jefferson City	Missouri	30	16	1.3	7.2
Helena	Montana	30	40	1.1	9.4
Trenton	New Jersey	31	20	1.3	8.4
Sante Fe	New Mexico	31	30	1.5	12
Albany	New York	31	16	0.86	8.1
Gastonia	North Carolina	31	31	2.2	11
Bismarck	North Dakota	31	36	0.73	6.9
Columbus	Ohio	31	24	1.1	9.5
Oklahoma City	Oklahoma	3	25	0.69	9.9
Ponca City	Oklahoma	31	14	0.28	5.1
Portland	Oregon	31	36	1.1	11
Harrisburg	Pennsylvania	27	26	2.6	8.9
San Juan	Puerto Rico	22	2.3	<0.10	1.0
Providence	Rhode Island	31	23	0.78	8.2
Columbia	South Carolina	30	33	1.9	8.8
Pierre	South Dakota	31	31	1.2	8.5
Nashville	Tennessee	31	36	1.6	9.5
Austin	Texas	30	22	1.3	7.7
El Paso	Texas	29	70	1.8	13
Salt Lake City	Utah	31	38	1.3	8.9
Richmond	Virginia	31	22	3.5	8.9
Seattle	Washington	26	8.7	1.0	3.1
Madison	Wisconsin	31	21	1.2	7.1
Cheyenne	Wyoming	31	28	0.58	8.3
Sundance	Wyoming	2	22	8.3	15
Network average					8.4

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Robert A. Taft Sanitary Engineering Center, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period September 11-October 6, 1961, appears in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22,* No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS, SEPTEMBER 11-OCTOBER 6, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
September 11	0808	71.8	86.2	780	130	8.5	<0.01
12	0805	23.9	29.3	710	140	6.2	—
13	0808	24.0	29.5	460	70	4.4	0.02
14	0808	24.0	29.0	140	130	2.3	0.05
15	0805	23.9	29.1	140	50	1.1	0.57
18	0815	72.1	89.4	1080	140	2.0	12.96
19	0812	23.9	30.4	850	190	8.0	30.10
20	0807	23.9	30.3	570	180	6.4	16.04
21	0815	24.1	30.0	580	150	4.3	15.44
22	0804	23.8	29.9	470	110	4.6	44.97
25	0810	72.1	90.7	250	120	5.3	3.35
26	0810	24.0	30.0	160	70	1.2	0.95
27	0815	24.0	30.0	1370	130	11.0	2.86
28	0805	23.8	29.4	250	170	5.8	2.99
29	0800	23.9	29.1	1010	160	7.4	5.38
October 2	0810	72.1	87.6	230	100	2.0	3.27
3	0802	23.8	29.2	170	120	1.7	4.93
4	0811	24.1	29.8	1080	120	4.3	5.99
5	0807	23.9	29.4	450	120	4.5	5.08
6	0802	23.9	29.2	900	190	4.9	8.47
Average				580	130	4.8	8.2
Range of counting errors (2σ)							
Maximum				64	23	1.1	0.6
Minimum				21	14	0.3	0.01

Radioactivity Measurements In Surface Air

U.S. Naval Research Laboratory

Radioactivity measurements of air-filter samples collected at various sites near the 80th Meridian (West) are made by the U.S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during August 1961 is presented in table 1, and the radioactivity profile for the same month and the second quarter of 1961 are shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air. The concentrations in table 1 are expressed in disintegrations per minute per cubic meter of air at the collecting site (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

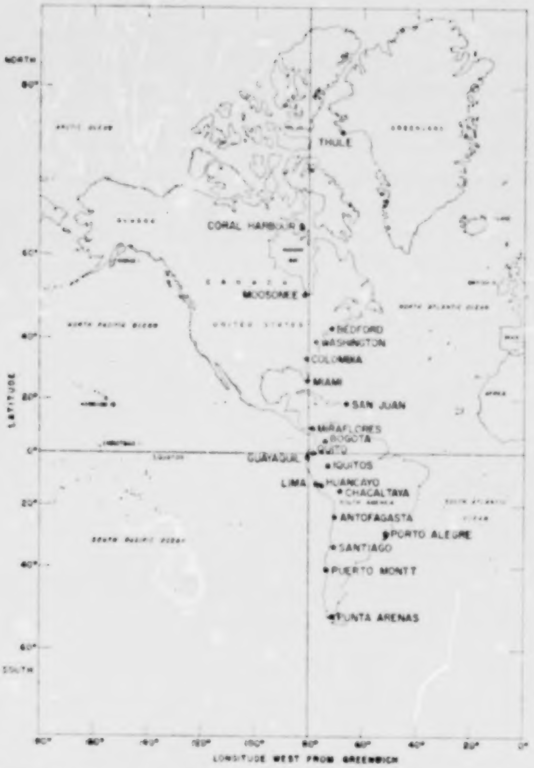
NORTH
80°
60°
40°
20°
0°
20°
40°
60°
SOUTH
LATITUDE
THULE
CORAL HARBOUR
MOOSONEE
BEDFORD
WASHINGTON
COLOMBIA
MIAMI
SAN JUAN
MIRAFLORES
BOGOTA
QUITO
GUAYAQUIL
IQUITOS
LIMA
HUANCAYO
CHACALTAYA
ANTOFAGASTA
PORTO ALEGRE
SANTIAGO
PUERTO MONTT
PUNTA ARENAS
80°
100°
80°
60°
40°
20°
0°
LONGITUDE WEST FROM GREENWICH

Figure 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

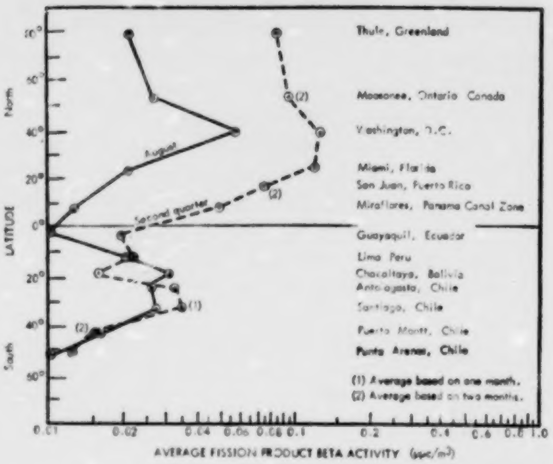

Figure 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), SECOND QUARTER AND AUGUST 1961

Table 1.—DAILY RECORD OF FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, AUGUST 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	0.03	0.05		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
2	0.03	0.05		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
3	0.02	0.06		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
4	0.02	0.06		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
5	0.02	0.04		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
6	0.02	0.04		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
7	0.02	0.04		0.04	0.11	0.04	0.04	0.04	0.06	0.14	0.06	0.08
8	0.03	0.03	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
9	0.03	0.03	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
10	0.01	0.06	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
11	0.01	0.06	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
12	0.03	0.03	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
13	0.03	0.03	0.05	0.06	0.06	0.07	0.01	0.02	0.04	0.17	0.07	0.05
14	0.03	0.03	0.05	0.06	0.03	0.07	0.01	0.02	0.04	0.17	0.07	0.05
15		0.04	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
16	0.02	0.04	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
17	0.03	0.03	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
18	0.03	0.03	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
19	0.02	0.01	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
20	0.02	0.01	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
21	0.02	0.01	0.08	0.05	0.03	0.04	0.01	0.02	0.03	0.17	0.07	0.04
22		0.04	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
23		0.04	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
24		0.04	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
25		0.04	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
26		0.03	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
27		0.03	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
28		0.03	0.07		0.09	0.03	0.02	0.03		0.04	0.04	0.02
29	<0.01	0.03	0.03	0.12	0.04	0.07	0.02	0.03	0.07	0.10	0.06	0.04
30	<0.01	0.03	0.03	0.12	0.04	0.07	0.02	0.03	0.07	0.10	0.06	0.04
31	<0.01	0.03	0.03	0.12	0.04	0.07	0.02	0.03	0.07	0.10	0.06	0.04
Mean (dpm/m³	0.022	0.036	0.062	0.059	0.068	0.047	0.020	0.028	0.047	0.127	0.060	0.047
Mean (μμc/m³)	0.010	0.016	0.028	0.026	0.031	0.021	0.010	0.013	0.021	0.057	0.027	0.021

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National Air Sampling Network

Division of Air Pollution, Public Health Service

The Public Health Service developed its National Air Sampling Network in 1953 to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, climate, and other factors associated with air quality.

The current basic network consists of 103 sampling stations operating every year in 66 large cities and 37 nonurban areas. In addition to these every-year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of *Radiological Health Data*.

The network stations are manned by cooperating Federal, State, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2000 cubic meters of air are collected on glass fiber filters on a biweekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and State health departments. A comprehensive report on the first five years of operation of the Network is contained in the publication, *Air Pollution Measurements of the National Air Sampling Network*, Public Health Service Publication No. 637, 1958; for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., price $2.00. Gross beta activity, by States, for the years 1953 through 1958 was submitted by the Chief, Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearing on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 173–185.

Previous data on gross beta activities of particulates in surface air were published in *Radiological Health Data*, Volume I, Numbers 7 and 8, and Volume II, Numbers 1, 4, 7 and 10. Data for the third quarter 1961 are presented in tables 1 and 2 respectively. The increased levels are due to the resumption of atmospheric nuclear weapons testing during September by the USSR. The maximum values may not portray an accurate presentation, as some stations may have completed their sampling for the quarter prior to the arrival of fallout.

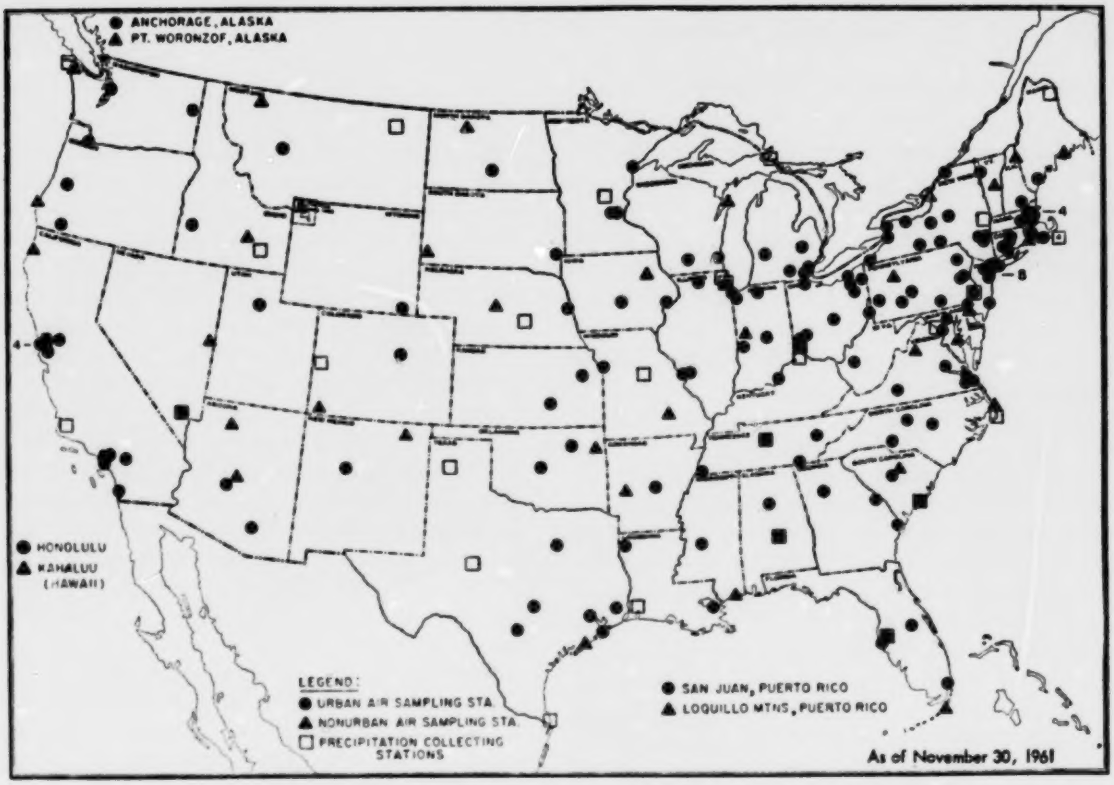
ANCHORAGE, ALASKA
PT. WORONZOF, ALASKA
HONOLULU
KAHALUU (HAWAII)
LEGEND:
URBAN AIR SAMPLING STA.
NONURBAN AIR SAMPLING STA.
PRECIPITATION COLLECTING STATIONS
SAN JUAN, PUERTO RICO
LOQUILLO MTNS, PUERTO RICO
As of November 30, 1961
4
4
8

FIGURE 1.—NATIONAL AIR SAMPLING NETWORK SAMPLING STATIONS

TABLE 1.—GROSS BETA RADIOACTIVITY IN SURFACE AIR, THIRD QUARTER 1961

[Concentrations in $\mu\mu c/m^3$]

Station location	Number of samples	Minimum	Maximum	Average
Arcadia Nat. Pk., Maine [1]	7	<0.1	6.3	1.1
Akron, Ohio	7	0.1	0.6	0.2
Albany, N.Y	6	<0.1	20.0	3.4
Albuquerque, N.M	4	0.1	0.2	0.1
Allentown, Pa	7	0.1	16.9	4.6
Altoona, Pa	5	0.1	8.7	3.0
Anchorage, Alaska	7	<0.1	12.2	1.8
Atlanta, Ga	6	<0.1	0.2	0.1
Atlantic City, N.J	6	<0.1	0.1	0.1
Augusta, Ga	7	<0.1	12.3	2.3
Austin, Tex	6	<0.1	0.1	<0.1
Baltimore, Md	7	<0.1	5.2	0.8
Beaumont, Tex	6	<0.1	1.1	0.2
Berkeley, Calif	7	<0.1	19.8	3.8
Bethlehem, Pa	6	0.1	0.2	0.1
Binghamton, N.Y	6	0.1	2.0	0.4
Birmingham, Ala	7	<0.1	7.5	1.5
Bismarck, N.D	7	0.1	5.9	1.0
Black Hills Frst., S.D. [1]	3	0.1	0.1	0.1
Boise, Idaho	7	0.1	14.3	3.3
Boston, Mass	6	<0.1	0.8	0.2
Brockton, Mass	7	0.1	11.0	1.7
Burlington, Vt	7	<0.1	1.1	0.2
Butte County, Idaho [1]	6	0.1	4.0	0.8
Calvert County, Md. [1]	6	<0.1	0.1	0.1
Cambridge, Mass	7	<0.1	53.0	7.9
Canton, Ohio	7	0.1	9.8	1.5
Cape Hatteras, N.C. [1]	7	<0.1	31.0	5.7
Cape Vincent, N.Y. [1]	7	<0.1	6.7	1.2
Charleston, S.C	6	<0.1	9.8	1.7
Charleston, W. Va	7	<0.1	3.9	0.6
Charlotte, N.C	7	<0.1	3.3	0.8
Chattanooga, Tenn	7	<0.1	11.0	1.6
Cherokee County, Okla. [1]	7	<0.1	9.1	1.4
Cheyenne, Wyo	7	<0.1	46.2	7.3
Chicago, Ill	6	<0.1	0.2	0.1
Cincinnati, Ohio	7	0.1	6.8	1.1
Clallam County, Wash [1]	6	<0.1	1.8	0.4
Clarion County, Pa. [1]	6	<0.1	8.1	1.4
Clayton County, Iowa [1]	7	<0.1	12.0	2.1
Cleveland, Ohio	7	<0.1	30.2	4.4
Colfax County, N. Mex. [1]	3	0.1	0.1	0.1
Columbia, S.C	7	<0.1	17.1	1.9
Columbus, Ohio	7	<0.1	63.9	9.6
Coos County, N.H. [1]	6	<0.1	22.1	5.8
Curry County, Oreg. [1]	6	<0.1	4.4	0.8
Dallas, Tex	4	<0.1	0.1	0.1
Davenport, Iowa	7	<0.1	15.3	2.6
Dayton, Ohio	7	<0.1	4.3	0.7
Dearborn, Mich	7	0.1	26.9	3.9
Denver, Colo	6	<0.1	1.6	0.3
Des Moines, Iowa	6	<0.1	8.8	1.9
Detroit, Mich	7	<0.1	36.1	5.2
Door County, Wis. [1]	3	0.1	14.6	4.9
Duluth, Minn	7	<0.1	7.8	1.3
East Chicago, Ind	5	<0.1	9.5	3.3
East St. Louis, Ill	6	<0.1	0.1	0.1
Elmira, N.Y	6	<0.1	0.2	0.1
Erie, Pa	5	<0.1	0.2	0.1
Eugene, Oreg	4	<0.1	0.6	0.2
Flint, Mich	7	0.1	12.2	1.8
Florida Keys, Fla. [1]	5	<0.1	4.9	1.8
Galveston, Tex	7	<0.1	9.0	1.4
Glacier Nat. Pk., Mont. [1]	6	<0.1	14.3	2.9
Glen Cove, N.Y	5	0.1	0.3	0.1
Glendale, Calif	7	<0.1	8.9	1.4
Grand Canyon Pk., Ariz. [1]	7	<0.1	5.4	1.4
Greensboro, N.C	6	<0.1	0.2	0.1

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TABLE 1.—GROSS BETA RADIOACTIVITY IN SURFACE AIR, THIRD QUARTER 1961—Continued

[Concentrations in $\mu\mu c/m^3$]

Station location	Number of samples	Minimum	Maximum	Average	Station location	Number of samples	Minimum	Maximum	Average
Hamilton, Ohio	7	0.1	8.0	1.3	Pittsburgh, Pa	7	0.1	3.1	0.5
Hammond, Ind	7	<0.1	10.2	1.5	Portland, Maine	7	<0.1	0.2	0.1
Hampton, Va	6	<0.1	2.6	0.5	Portland, Oreg	7	<0.1	6.9	1.0
Hartford, Conn	5	0.1	6.1	1.3	Portsmouth, Va	5	<0.1	75.0	15.1
Helena, Mont	5	0.1	0.2	0.1	Providence, R.I	4	<0.1	1.2	0.5
Honolulu, Hawaii	6	<0.1	4.2	1.1	Pt. Woronzof, Alaska [1]	7	<0.1	3.0	0.6
Houston, Tex	7	<0.1	7.6	1.5	Raleigh, N.C	6	<0.1	5.7	1.9
Humboldt County, Calif. [1]	6	<0.1	13.6	2.3	Richland County, S.C. [1]	6	<0.1	11.0	1.9
Indianapolis, Ind	5	0.1	0.1	0.1	Richmond, Va	7	<0.1	21.8	3.2
Jackson, Mich	6	0.1	5.2	1.0	Roanoke, Va	6	<0.1	0.2	0.1
Jackson, Miss	6	<0.1	1.6	0.3	Rochester, N.Y	7	<0.1	1.4	0.3
Jackson County, Miss. [1]	7	<0.1	247.9	35.4	Rockford, Ill	7	0.1	6.9	1.2
Jersey City, N.J	6	0.1	21.4	3.7	Salt Lake City, Utah	6	<0.1	17.3	5.4
Johnstown, Pa	5	<0.1	8.0	3.1	San Antonio, Tex	7	<0.1	227.7	34.6
Kahaluu, Hawaii [1]	7	<0.1	2.0	0.6	San Bernardino, Calif	7	<0.1	8.6	1.5
Kansas City, Mo	6	0.1	7.1	1.8	San Diego, Calif	7	0.1	6.2	1.3
Kent County, Del [1]	6	0.1	6.5	1.2	San Francisco, Calif	6	<0.1	2.0	0.4
Knoxville, Tenn	7	<0.1	9.2	1.6	San Jose, Calif	7	<0.1	11.1	2.1
Las Vegas, Nev	5	0.1	53.0	10.9	San Juan, P.R	6	<0.1	3.7	0.8
Little Rock, Ark	6	<0.1	0.1	0.1	Savannah, Ga	7	<0.1	12.2	1.8
Long Beach, Calif	6	<0.1	2.9	0.6	Schenectady, N.Y	6	<0.1	5.0	0.9
Loquillo Mtns., P.R. [1]	7	<0.1	1.8	0.3	Scranton, Pa	7	0.1	5.3	0.9
Los Angeles, Calif	7	<0.1	8.6	1.4	Seattle, Wash	7	<0.1	5.1	0.9
Louisville, Ky	6	<0.1	8.3	1.5	Shannon County, Mo. [1]	7	<0.1	6.6	1.1
Lowell, Mass	6	<0.1	24.4	4.8	Shenandoah Nat. Pk., Va. [1]	4	<0.1	17.9	4.5
Madison, Wis	6	<0.1	38.8	6.6	Shreveport, La	6	<0.1	262.9	44.2
Manchester, N.H	4	0.1	17.5	6.0	Sioux Falls, S.D	7	<0.1	12.3	2.6
Maricopa County, Ariz. [1]	7	0.1	11.6	1.8	South Bend, Ind	7	<0.1	9.5	1.4
Massena, N.Y	7	0.1	5.5	0.9	Spokane, Wash	7	0.1	10.5	1.7
Medford, Oreg	7	0.1	48.0	7.5	St. Louis, Mo	7	0.1	12.0	2.4
Memphis, Tenn	7	<0.1	6.7	1.0	St. Paul, Minn	7	<0.1	12.0	2.0
Miami, Fla	6	<0.1	1.0	0.2	St. Petersburg, Fla	7	<0.1	31.7	4.6
Milwaukee, Wis	7	<0.1	8.8	1.5	Stockton, Calif	7	<0.1	19.8	2.9
Minneapolis, Minn	7	<0.1	15.9	2.3	Syracuse, N.Y	7	<0.1	6.0	1.0
Montezuma County, Colo. [1]	7	0.1	28.1	5.3	Tampa, Fla	6	<0.1	0.2	0.1
Montgomery, Ala	7	0.1	7.4	1.1	Terre Haute, Ind	7	0.1	7.2	1.3
Montgomery County, Ark. [1]	6	<0.1	0.1	<0.1	Thomas County, Nebr. [1]	7	0.1	9.9	1.5
Montgomery County, Ind. [1]	7	<0.1	7.7	1.1	Toledo, Ohio	5	0.1	4.1	0.9
Mt. Vernon, N.Y	6	<0.1	0.1	0.1	Topeka, Kans	7	<0.1	11.0	1.7
Nashville, Tenn	6	<0.1	8.5	1.5	Troy, N.Y	5	<0.1	0.1	0.1
New Bedford, Mass	6	<0.1	43.6	8.7	Tulsa, Okla	6	<0.1	12.6	2.2
New Britain, Conn	4	0.1	0.1	0.1	Tucson, Ariz	6	<0.1	0.5	0.1
New Haven, Conn	7	0.1	15.6	2.3	Utica, N.Y	7	0.1	11.4	1.9
New Orleans, La	7	<0.1	10.7	1.9	Ward County, N.D. [1]	6	<0.1	0.1	0.1
New Rochelle, N.Y	4	0.1	0.2	0.1	Washington, D.C	4	<0.1	0.1	0.1
New York, N.Y	6	0.1	0.2	0.1	Washington County, R.I. [1]	7	0.1	5.0	1.0
Newark, N.J	7	<0.1	4.5	0.7	Waterbury, Conn	6	<0.1	0.2	0.1
Niagara Falls, N.Y	5	<0.1	19.7	4.0	Wheeling, W. Va	6	<0.1	9.6	1.7
Norfolk, Va	7	<0.1	5.9	0.9	White Pine County, Nev. [1]	6	<0.1	20.3	3.7
Oakland, Calif	6	<0.1	4.8	0.9	Wichita, Kans	6	0.1	0.2	0.1
Oklahoma City, Okla	7	0.1	243.7	35.7	Wilmington, Del	6	0.1	0.1	0.1
Omaha, Nebr	7	<0.1	3.6	0.6	Worcester, Mass	5	0.1	22.7	4.6
Orange County, Vt. [1]	7	<0.1	6.1	0.9	Yellowstone Pk., Wyo. [1]	7	0.1	16.9	3.7
Orlando, Fla	5	<0.1	16.8	3.4	York, Pa	7	<0.1	46.5	7.4
Philadelphia, Pa	7	<0.1	4.9	0.8	Youngstown, Ohio	7	<0.1	1.6	0.3
Phoenix, Ariz	7	<0.1	21.0	3.2					

[1] Nonurban station.

Gross Beta Radioactivity in Precipitation

National Air Sampling Network, Precipitation Collection Section, Division of Air Pollution, Public Health Service

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincinnati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau offices or airport stations. Monthly composite samples of precipitation are collected at 30 stations and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85 percent

or more of the official rainfall recorded at the collecting stations are analyzed for fission product gross beta radioactivity, if a large enough volume remains after the requirements for the chemical analysis have been met. Previous data were presented in *Radiological Health Data*, Volume I, Numbers 7 and 8, and Volume II, Numbers 1, 4, 7, and 10.

PRECIPITATION COLLECTION STATIONS

National Air Sampling Network

Alabama: Montgomery
California: Santa Maria
Colorado: Grand Junction
Florida: Tampa
Idaho: Pocatello
Illinois:
  Chicago (Midway Airport)
  Chicago (O'Hare Airport)
Louisiana: Lake Charles
Maine: Caribou
Maryland: Silver Hill
Massachusetts: Nantucket
Michigan: Sault Ste. Marie
Minnesota: St. Cloud
Missouri: Columbia
Montana: Glasgow
Nebraska: Grand Island
Nevada: Las Vegas
New York: Albany
North Carolina: Cape Hatteras
Ohio:
  Cincinnati (research station)
  Cincinnati (airport)
Pennsylvania: Philadelphia
South Carolina:
  Charleston
  Greenville
Tennessee: Nashville
Texas:
  Brownsville
  San Angelo
  Amarillo
Virginia: Sterling
Washington: Tatoosh Island

TABLE 1.—GROSS BETA RADIOACTIVITY OF PRECIPITATION, THIRD QUARTER 1961

Station	July		August		September	
	μμc/liter	μμc/m²	μμc/liter	μμc/m²	μμc/liter	μμc/m²
Albany, N. Y.	18	1,900	7	800	84	5,200
Amarillo, Tex.	33	2,400	9	600	[a] —	—
Brownsville, Tex.	—	—	4	300	44	11,900
Cape Hatteras, N. C.	9	500	3	700	18	1,400
Caribou, Maine	34	2,800	16	2,000	36	4,500
Charleston, S. C.	6	700	5	600	9	500
Chicago, Ill. (Midway)	16	1,200	16	1,400	38	12,400
Chicago, Ill. (O'Hare)	36	2,800	—	—	52	14,300
Cincinnati, Ohio (Airport)	11	1,200	—	—	—	—
Cincinnati, Ohio	8	1,000	18	1,600	56	4,000
Columbia, Mo.	8	1,100	—	—	23	4,900
Grand Island, Nebr.	12	1,300	—	—	371	20,000
Greenville, S. C.	4	400	8	1,600	—	—
Lake Charles, La.	7	1,300	17	1,500	12	1,000
Montgomery, Ala.	7	700	6	1,100	—	—
Nantucket, Mass.	44	6,500	—	—	131	11,700
Nashville, Tenn.	5	400	12	600	—	—
Philadelphia, Pa.	13	1,400	9	700	23	1,300
Saulte St. Marie, Mich.	—	—	—	—	145	18,600
St. Cloud, Minn.	26	2,100	14	1,000	1,257	97,300
Sterling, Va.	17	1,200	16	1,300	27	2,300
Tampa, Fla.	3	300	—	—	—	—

[a] Dash indicates no data available due to low collection efficiency or inadequate sample.

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SECTION II. — FOOD OTHER THAN MILK

Strontium-90 in U.S. Wheat Harvested in 1960[1]

Joseph Rivera
Health and Safety Laboratory, U.S. Atomic Energy Commission

Preliminary results on the strontium-90 and calcium content of U.S. wheat harvested in 1960 are presented below. Data on wheat harvested in 1959 in the same state, are presented with the 1960 results to facilitate comparison. A pictorial representation of the data is presented in figure 1. Each cube, scaled to represent the concentration, is placed on the appropriate state.

The effects of the decreased fallout rate in

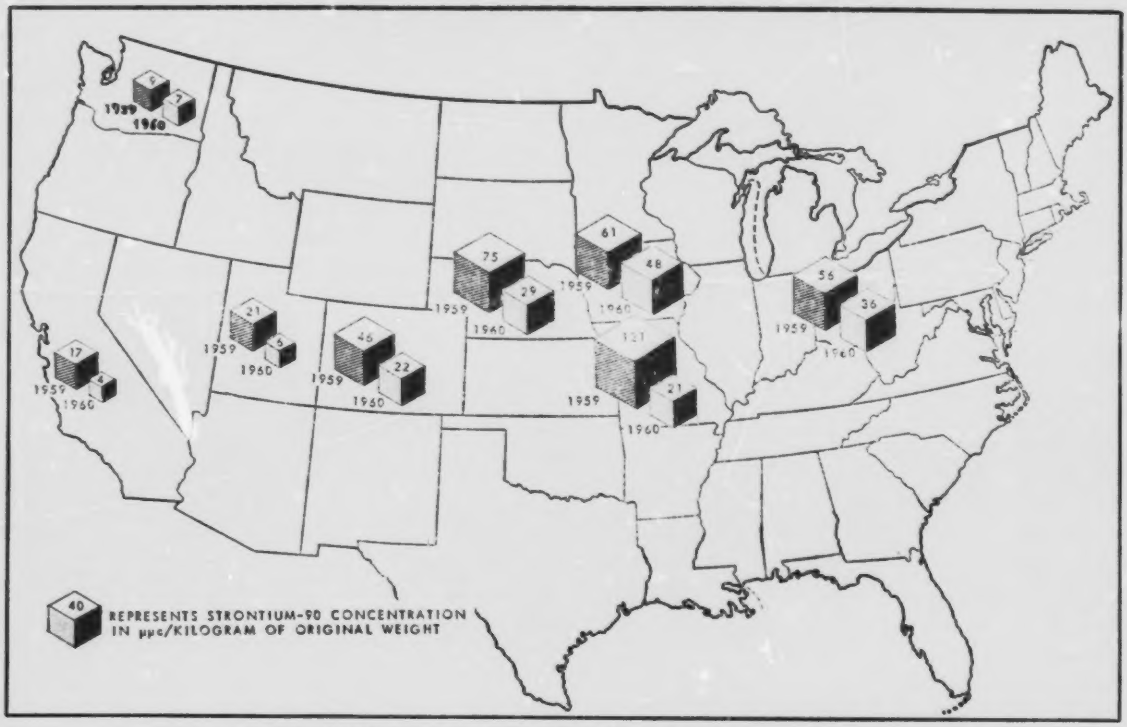
9
7
1959
1960
17
4
1959
1960
21
6
1959
1960
46
22
1959
1960
75
29
1959
1960
61
48
1959
1960
121
21
1959
1960
56
36
1959
1960
40
REPRESENTS STRONTIUM-90 CONCENTRATION IN μμc/KILOGRAM OF ORIGINAL WEIGHT

FIGURE 1.—STRONTIUM-90 IN U.S. WHEAT HARVESTED IN 1959 AND 1960

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[1] Taken from *Quarterly Summary Report, HASL-115*, October 1, 1961.

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TABLE 1.—STRONTIUM-90 IN U. S. WHEAT, 1959–1960

State	μμc/kg original weight		μμc/gm Ca	
	1959	1960	1959	1960
California	17	4	49	11
Colorado	46	22	71	45
Iowa	61	48	109	89
Missouri	121	21	272	50
Nebraska	75	29	159	60
Ohio	56	36	152	72
Utah	21	6	45	15
Washington	9	7	29	20

1960 as compared to that in 1959 are evident in the observed decreased strontium–90 levels in the 1960 wheat crop. The fallout rate in the United States in 1959 for the harvest months of May, June, July, and August is estimated to have been about 1.4 mc $Sr^{90}/mi^2/mo$, while in 1960 the rate was about 0.3 mc $Sr^{90}/mi^2/mo$. The increase in the cumulative strontium–90 in the soils on which the wheat was grown is estimated to have been from 66 mc/mi^2 at the end of 1959 to 70 mc/mi^2 at the end of 1960.

A more quantitative estimate of the relative importance of the fallout rate and the cumulative strontium–90 levels in the soil on the strontium–90 content of wheat will be attempted when the results of analyses on the 1960 wheat and milling products from seven additional states are available.

Other data on wheat have been presented in *Radiological Health Data,* Volume I, Numbers 2, 7 and 8 and Volume II, Numbers 4 and 7.

Strontium-90 in Various Types of Grains[1]

Health and Safety Laboratory, U.S. Atomic Energy Commission

Samples of wheat, barley, oats, and rye were collected at one site and all but rye at another during two harvest periods, and analyzed for strontium–90 to ascertain whether correlations exist among grain types and between sites.

From the data in table 1 there appears to be no correlation between the strontium–90 level in a particular type of grain grown in Warsaw, Virginia and the same type grown in Lafayette, Indiana. Furthermore, there is considerable variability among grain types at a site with regard to strontium–90 activity per unit weight of grain as well as the strontium–90 activity per gram of calcium. Finally, no trend can be observed in the data between the two harvest periods.

It would be extremely difficult to isolate one factor as the predominant contributor to the variability among grain types, between sites, and between harvest periods.

TABLE 1.—COMPARISON OF STRONTIUM-90 AND CALCIUM LEVELS IN DIFFERENT GRAINS AT TWO SITES FOR TWO HARVEST PERIODS

Site	Year	Wheat			Barley			Oats			Rye		
		gm Ca/kg original material	μμc Sr^{90}/gm Ca	μμc Sr^{90}/kg original material	gm Ca/kg original material	μμc Sr^{90}/gm Ca	μμc Sr^{90}/kg original material	gm Ca/kg original material	μμc Sr^{90}/gm Ca	μμc Sr^{90}/kg original material	gm Ca/kg original material	μμc Sr^{90}/gm Ca	μμc Sr^{90}/kg original material
Warsaw, Va.	1959	0.31	92	28	0.34	156	53	0.83	103	86	0.35	232	80
	1959–60	0.34	104	35	0.36	151	54	0.84	97	81	0.36	158	58
Lafayette, Ind.	1959	0.35	130	45	0.54	46	25	0.74	23	17			
	1960	0.34	155	53	0.46	129	59	0.83	29	24			

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[1] Taken from *Quarterly Summary Report, HASL–115,* October 1, 1961.

Residual Radioactivity in Canadian Foods[1]

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Department of National Health and Welfare, Ottawa, Canada

The following data are from a study initiated to obtain data on past and current levels of residual radioactivity in the various types of food found on the Canadian market. Analytical work on samples already on hand, some of which were obtained as far back as 1945, was initiated in December 1959. The beta activity determinations were completed in August 1960. The results presented in this article do not lend themselves to a time-correlation study, since most of the samples were either passed to this laboratory by other agencies or obtained in a non-systematic way. A detailed outline of the experimental methods and standardization and calculation procedures are reported in *HASL–115*.[1] The full report is dated May 1961.

Total beta activity (excluding the contribution of potassium–40 and other alkali metals) for each variety of foods included in this initial

TABLE 1.—TOTAL BETA RADIOACTIVITY IN CANADIAN FOODS, 1945–1961

Variety	Year packed	Year purchased	Number of samples	Average[1] μμc/kg (fresh wt)
Cereals for babies:				
Barley	....	1959	3	[3] ND
Corn	....	1959	1	ND
Mixed	....	1959	3	17
Oats	....	1959	2	83
		1961	10	41
Rice	....	1959	3	ND
Wheat	....	1959	4	50
		1961	5	50
Cereals for adults:				
Barley	....	1960	1	48
Bran	....	1960	6	150
		1961	11	150
Corn	....	1960	5	11
Oat	....	1960	7	49
Rice	....	1960	3	14
Wheat	....	1960	17	57
		1961	1	110
Others	....	1960	19	53
Processed vegetables and fruits for babies:[2]				
Apple and raspberry	1950	....	1	ND
Beets	1945	....	1	10
	1951	....	1	ND
	1956	....	3	6.0
Celery	1949	....	1	ND
	1951	....	1	21
	1956	....	3	3.9
Mixed vegetables	1947	....	1	ND
	1949	....	5	ND
	1950	....	3	ND
	1951	....	3	ND
	1957	....	3	16
Mushroom	1948	....	1	8.4
	1950	....	1	ND
Peas	1949	....	3	6.4
	1950	....	2	ND
	1951	....	1	5.1
	1956	....	3	5.3
Peas and carrots	1949	....	1	ND
	1950	....	1	ND
Spinach	1945	....	1	22
	1948	....	1	10
	1949	....	1	ND
	1956	....	3	13
Squash	1949	....	1	ND
Miscellaneous processed foods for babies:[2]				
Orange custard	1949	....	2	8.0
	1951	....	1	ND
Meat broth [3]	1947	....	1	ND
	1948	....	2	6.0
	1949	....	2	ND
	1950	....	1	ND
	1951	....	5	2.6
Fruit Juice:[2]				
Tomato	1949	....	11	14
Processed fruits:[2]				
Tomatoes	1949	....	4	18
Apricots	1961	....	5	24
Dried fruits:				
Apples	....	1960	2	34
Apricots	....	1960	2	220
		1961	5	150
Dates	....	1960	3	60
Figs	....	1960	8	140
Prunes	....	1960	2	39
Raisins	....	1960	5	83
Seafoods:				
Chicken haddies	....	1957	1	14
Clams	....	1957	3	29
Crab meat	....	1957	6	33
Fish cakes	....	1957	2	22
Lobster	....	1957	4	14
Oyster	....	1957	2	20
Sardines	....	1957	3	ND
Sea trout	....	1957	1	ND
Shrimp	....	1957	3	8.3
Tuna	....	1957	11	18
Salmon:				
Keta				
Canada	....	1957	8	40
Japan	....	1957	0	....
Medium red cohoe				
Canada	....	1957	2	91
Japan	....	1957	2	80
Pink				
Canada	....	1957	13	14
Japan	....	1957	7	27
Red cohoe				
Canada	....	1957	5	5.0
Japan	....	1957	10	30
Red sockeye				
Canada	....	1957	27	22
Japan	....	1957	13	19
Bone flour	....	1959	10	5700
	....	1960	2	5900
Beverage ingredients:				
Cereal	....	1961	8	160
Cocoa	....	1961	5	270
Coffee	....	1961	2	140
Coffee (instant)	....	1961	1	200
Tea:				
Broken orange pekoe				
Ceylon	1958	....	2	1200
Formosa	1959	....	1	3900
Iran	1958	....	1	2900
Japan	1958	....	1	1600
Broken pekoe				
Ceylon	1958	....	4	1300
	1959	....	2	1300
Kenya	1959	....	1	1700
Black				
Ceylon	1958	....	1	580
Formosa	1958	....	1	2200

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[1] Data from *Quarterly Summary Report, HASL–115*, October 1, 1961.

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TABLE 1.—TOTAL BETA RADIOACTIVITY IN CANADIAN FOODS, 1945–1961—Continued

Variety	Year packed	Year purchased	Number of samples	Average[1] µµc/kg (fresh wt)
Mozambique	1959	----------	1	790
Black broken				
Amaravilla	1958	----------	1	600
Japan	1958	----------	1	780
Black fannings				
Ceylon	1958	----------	1	1900
	1959	----------	4	2000
Kasaky	1958	----------	1	750
Kenya	1959	----------	1	2300
Nyasaland	1958	----------	1	440
Green				
Japan	1958	----------	3	4600
	1959	----------	1	7900
Green siftings				
Japan	1958	----------	1	9500
	1956	----------	1	7400
Green pan-fired				
Japan	1958	----------	2	2600
Tea mixture				
Ceylon	1958	----------	2	830
	1959	----------	3	870
Iran	1958	----------	2	790
Broken mixture				
Ceylon	1959	----------	3	1500
Mixed fannings				
Ceylon	1958	----------	5	3500
	1959	----------	7	1800
Tea dust				
Ceylon	1959	----------	1	1500
Uganda	1958	----------	1	490
Tamella broken				
Ceylon	1959	----------	1	990

[1] Excludes the contribution of potassium-40 and other alkali metals.
[2] Values given refer to one liter of the commercial preparation.
[3] ND—Not detectable.

survey are given in table 1. In general, results are in line with published data from other countries. Bran cereals were the highest for the cereal foods. Processed vegetables and fruits were all noticeably low. Apricots and figs ranked highest for the dried fruits. The medium red cohoe salmon variety showed a higher average than other seafoods. It will be noted that salmon packed in Japan, when compared to similar types packed in Canada, had activity values of the same order of magnitude. The only exception was the red cohoe variety. Values for bone flour were high. However, due to its high calcium content, the reported activities measured in µµc Sr^{90}/gmCa units would be expected to be below 10. Tea leaves, when compared to other beverage ingredients such as cocoa, coffee, and cereals, yielded activity values which ran from 2 to 30 times higher. It was found, however, that only 10 to 16 percent of this activity passed into water solution under normal conditions, as shown in table 2. The average activity was 1.05 µµc per cup of tea for six different varieties. The average values for each type of food have been summarized in table 3.

It is planned to extend the survey to other types of food. Some of those listed in table 1 are being checked with further samples. Absolute strontium-90 and calcium determinations will be conducted on a number of samples from each type.

TABLE 2.—PERCENTAGE OF THE ORIGINAL BETA ACTIVITY PASSING INTO SOLUTION WITH DIFFERENT VARIETIES OF TEA

Original solid µµc/kg (fresh weight)	Solid[1] residue µµc/kg [2]	Solution		
		µµc/kg [2]	µµc/cup	Percent of original solid activity
2400	2200	350	0.80	14.6
4400	3200	440	1.20	10.0
3900	3200	390	1.10	10.0
1700	1400	270	0.90	15.9
1600	1300	260	0.70	16.6
7400	5800	650	1.00	8.8

[1] Solid residue refers to that amount of original solids remaining after tea is made.
[2] Refers to *kilogram of original solid* (fresh weight) used to prepare the solution. Recipe: one teaspoon of tea per cup of boiling water. Standing time before filtering: 30 minutes.

TABLE 3.—SUMMARY OF TOTAL BETA RADIOACTIVITY IN CANADIAN FOODS, 1945–1961

Type of food	Number of samples	Average µµc/kg (fresh wt)
Cereals for babies	31	38
Cereals for adults	70	73
Processed vegetables and fruits for babies [2]	46	5.9
Miscellaneous processed foods for babies [2]	3	5.3
Meat broth [2]	11	1.5
Fruit juice [2]	11	14
Processed fruits [2]	9	21
Dried fruits	27	110
Sea foods	123	23
Bone flour	12	5700
Cereal beverages	8	160
Cocoa	5	270
Coffee	3	160
Tea	58	2200

[1] Excludes contribution of potassium-40 and other alkali metals.
[2] Values given refer to one liter of the commercial preparation.

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SECTION III. — MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a processed (pasteurized) milk sampling program designed to

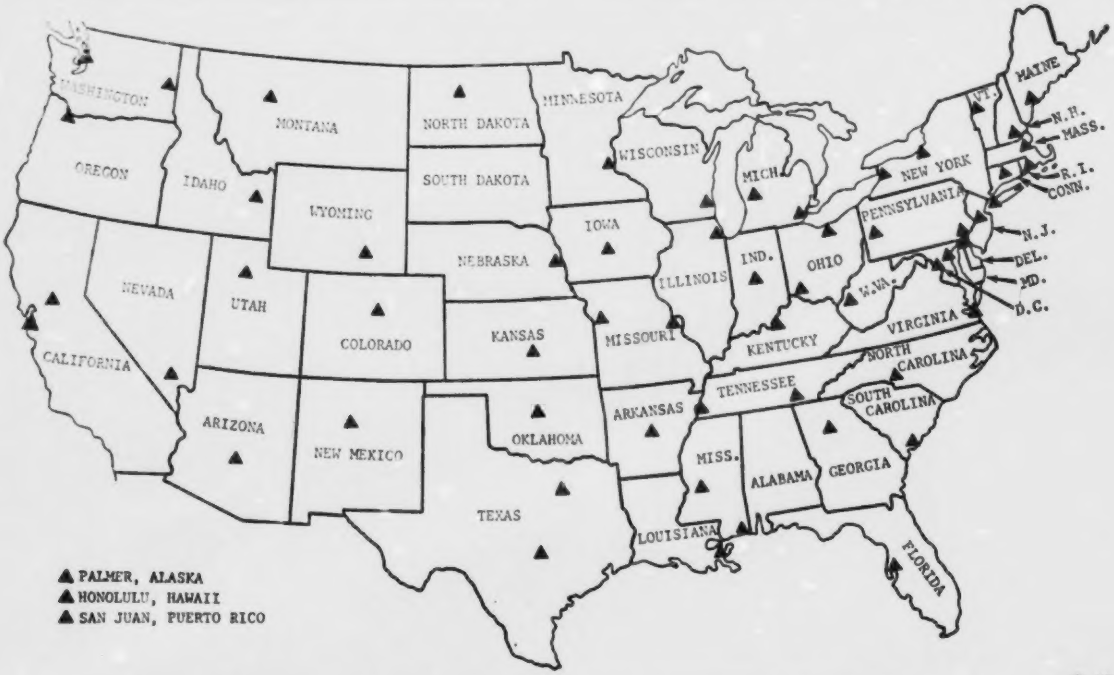
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MISS.
MICH.
IND.
KENTUCKY
TENNESSEE
ALABAMA
OHIO
W.VA.
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
PENNSYLVANIA
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
D.C.
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS

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provide data represenative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *Radiological Health Data* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

Pasteurized milk surveillance is currently conducted at 60 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies, who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the Western states. Publication of data follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized and homogenized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within each state and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

Radioassays for strontium–90, cesium–137, strontium–89, barium–140, and iodine–131 are performed. The values for strontium–89,

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, SECOND QUARTER AND AUGUST 1961

[Radioactivity concentrations in $\mu\mu c$/liter]

Area	Calcium (gm/liter)		Strontium-90		Cesium-137	
	Second quarter	August	Second quarter	August	Second quarter	August
Palmer, Alaska	1.03	1.22	9	7	5	<5
Little Rock, Ark	1.21	1.18	19	16	25	10
Phoenix, Ariz	0.97	1.04	5	4	5	<5
Sacramento, Calif	1.05	1.02	5	4	<5	<5
San Francisco, Calif	1.04	1.01	5	5	10	<5
Denver, Colo	1.01	1.04	6	6	5	10
Hartford, Conn	1.17	1.16	9	8	30	20
Wilmington, Del	1.20	1.20	10	12	15	10
Washington, D.C	1.18	1.12	8	7	20	10
Tampa, Fla	1.23	1.26	6	5	110	85
Atlanta, Ga	1.29	1.28	10	10	20	15
Honolulu, Hawaii	0.96	1.05	4	6	10	10
Idaho Falls, Idaho	1.04	1.04	5	6	10	<5
Chicago, Ill	1.17	1.15	8	4	10	10
Indianapolis, Ind	1.23	1.19	8	6	10	<5
Des Moines, Iowa	1.01	1.00	7	6	5	5
Wichita, Kans	1.01	1.04	8	7	10	<5
Louisville, Ky	1.18	1.18	11	8	10	10
New Orleans	1.30	1.30	13	14	20	30
Portland, Maine	1.26	1.21	10	10	40	35
Baltimore, Md	1.23	1.15	8	10	15	10
Boston, Mass	1.21	1.19	11	9	35	30
Detroit, Mich	1.17	1.12	8	6	15	10
Grand Rapids	1.25	1.17	7	6	15	10
Minneapolis, Minn	1.07	1.12	7	11	10	15
Jackson, Miss	1.35	1.22	14	12	15	10
Kansas City, Mo	[a] 1.08	1.00	[a] 12	8	[a] 15	<5
St. Louis, Mo	1.09	1.03	8	6	20	10
Helena, Mont	1.02	1.06	6	4	10	5
Omaha, Nebr	1.07	1.06	6	9	10	10
Manchester, N.H	1.23	1.17	12	10	45	40
Trenton, N.J	1.17	1.13	9	8	15	10
Albuquerque, N. Mex	1.06	1.12	5	5	5	<5
Buffalo, N.Y	1.22	1.16	8	6	15	10
New York, N.Y	1.17	1.10	9	6	25	15
Syracuse, N.Y	1.19	1.11	7	6	15	<5
Charlotte, N.C	1.26	1.26	12	13	15	10
Cincinnati, Ohio	1.24	1.24	9	7	10	<5
Cleveland, Ohio	1.20	1.12	8	8	10	<5
Oklahoma City Okla	1.22	1.20	8	6	5	<5
Portland, Oreg	1.05	1.10	12	13	30	10
Philadelphia, Pa	1.18	1.18	9	9	15	15
Pittsburgh, Pa	1.27	1.14	12	10	20	10
San Juan, P.R	1.23	1.18	4	4	5	10
Providence, R.I	1.17	1.10	10	13	40	30
Charleston, S.C	1.25	1.24	12	12	25	25
Chattanooga, Tenn	1.33	1.29	11	12	15	15
Memphis, Tenn	1.30	1.24	13	12	10	<5
Austin, Tex	1.24	1.24	3	2	5	<5
Dallas, Tex	1.24	1.16	9	6	10	<5
Salt Lake City Utah	1.01	1.11	5	4	10	<5
Burlington, Vt	1.22	1.14	8	8	15	15
Norfolk, Va	1.26	1.22	9	8	20	10
Seattle, Wash	1.03	1.06	9	8	25	15
Spokane, Wash	1.02	1.04	8	12	15	20
Charleston, W. Va	1.20	1.12	9	10	15	10
Milwaukee, Wis	1.19	1.13	6	4	20	10
Laramie, Wyo	1.00	1.08	5	5	10	10
Average	1.16	1.14	8	8	15	10

[a] Average based on two month's samples.

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barium-140, and iodine-131 for August 1961 were below the levels of detection by current instrumentation and are therefore not shown in table 1. The lower level of detection for strontium-89 is 5 μμc/liter, and for barium-140 and iodine-131, 10 μμc/liter. Other radionuclides of concern to public health agencies will be included for assay as necessary for a more complete monitoring of the milk supply.

Following resumption of nuclear weapons testing in the atmosphere, the frequency of sampling was accelerated. Daily sampling of processed milk with analyses for iodine-131 content was initiated on September 19, at selected stations. The data for September 19 through October 31, 1961, have been reported in *Radiological Health Data*, Volume II, Numbers 11 and 12.

TABLE 2.—IODINE-131 DETERMINATIONS, PROCESSED MILK AREA SAMPLING STATIONS, NOVEMBER 1-30, 1961

[Concentrations in μμc/liter]

Station location	November																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Palmer, Alaska	—	50	—	—	60	50	—	—	70	—	—	—	—	—	—	—	60	—	—	—	<10	<10	—	—	—	<10	—	<10	—	<10
Phoenix, Ariz	—	—	110	—	—	130	—	70	—	—	—	—	—	90	—	70	—	—	—	80	—	—	30	—	—	—	40	—	—	30
Little Rock, Ark	—	—	70	—	—	—	150	—	—	250	—	—	—	180	—	—	180	—	—	—	140	—	—	60	—	—	—	—	—	—
Sacramento, Calif	60	50	100	—	—	60	70	70	—	50	—	—	30	30	30	30	30	—	—	20	20	20	20	—	<10	—	10	<10	<10	<10
San Francisco, Calif	—	40	—	—	—	40	—	—	30	—	—	—	20	—	—	—	—	—	—	20	—	—	—	<10	—	—	<10	—	—	<10
Denver, Colo	—	70	—	—	—	—	—	—	40	60	—	—	—	40	—	—	—	—	—	—	—	30	20	—	20	—	—	—	—	<10
Hartford, Conn	—	—	60	—	—	—	50	—	—	30	—	—	—	20	—	—	30	—	—	—	10	—	—	10	—	—	—	<10	—	—
Wilmington, Del	—	—	140	—	—	—	70	—	—	60	—	—	—	40	—	—	50	—	—	—	30	—	—	30	—	—	—	20	—	—
Washington, D. C	60	—	50	—	—	40	—	50	—	40	30	—	—	40	—	40	—	—	—	10	—	—	30	—	—	—	—	10	—	30
Tampa, Fla	50	—	—	—	—	50	—	50	—	40	—	—	50	—	50	—	50	—	—	40	—	60	—	—	—	—	10	—	20	—
Atlanta, Ga	30	—	—	—	—	30	—	40	—	—	—	—	40	—	40	—	30	—	—	60	—	60	—	50	—	—	40	—	10	—
Honolulu, Hawaii	—	—	—	—	—	—	10	—	30	—	—	—	—	10	—	—	20	—	—	—	<10	—	—	20	—	—	—	10	—	—
Idaho Falls, Idaho	—	200	—	—	—	110	—	—	160	—	—	—	90	—	—	70	—	—	—	30	—	—	—	—	—	10	—	—	—	—
Chicago, Ill	130	100	90	—	—	120	130	120	130	140	—	—	80	110	90	130	80	—	—	40	40	30	—	50	—	—	10	<10	<10	10
Indianapolis, Ind	—	—	—	—	—	—	—	—	—	70	—	—	80	70	—	—	60	—	—	50	—	—	—	—	—	—	—	20	—	—
Des Moines, Iowa	—	—	200	—	—	250	—	—	310	—	—	—	250	—	—	—	240	—	—	130	—	—	—	180	—	—	90	—	—	—
Wichita, Kans	90	—	80	—	100	—	—	320	—	340	—	—	—	—	220	—	260	—	—	—	130	—	—	70	—	40	—	50	—	—
Louisville, Ky	—	—	90	—	—	—	100	—	—	80	—	—	—	50	—	—	80	—	—	—	100	—	—	50	—	—	60	—	—	—
New Orleans, La	—	—	—	—	—	50	50	50	60	—	—	—	80	70	70	100	80	—	—	90	60	80	—	—	—	—	40	30	70	50
Portland, Maine	—	—	90	—	—	—	70	—	—	40	—	—	—	—	—	—	10	—	—	—	40	—	—	10	—	—	—	<10	—	—
Baltimore, Md	—	40	—	—	—	50	—	—	30	—	—	—	—	—	—	30	—	—	—	40	—	—	—	30	—	—	10	—	—	30
Boston, Mass	—	—	100	—	—	—	100	—	—	—	—	—	—	—	—	—	10	—	—	—	10	—	—	10	—	—	—	<10	—	—
Detroit, Mich	—	—	170	—	—	—	—	—	—	120	—	—	—	80	—	—	80	—	—	—	40	—	—	—	—	—	—	<10	—	—
Grand Rapids, Mich	—	—	160	—	—	—	—	—	—	80	—	—	—	—	40	—	60	—	—	—	30	—	—	10	—	—	—	10	—	—
Minneapolis, Minn	260	—	210	—	—	—	240	—	—	180	—	—	—	140	—	—	120	—	—	—	80	—	—	20	—	—	—	10	—	—
Jackson, Miss	40	—	60	—	—	40	—	80	—	—	—	—	70	—	80	—	90	—	—	80	—	60	—	—	—	—	30	—	70	—
Pascagoula, Miss	—	—	60	—	—	—	50	—	—	60	—	—	—	70	—	—	50	—	—	—	70	—	—	—	—	—	—	20	—	—
Kansas City, Mo	—	—	130	—	—	—	240	—	—	300	—	—	—	220	—	—	180	—	—	—	140	—	—	—	—	—	90	—	—	—
St. Louis, Mo	90	80	70	100	—	110	160	180	190	200	160	—	130	120	150	120	120	90	—	70	80	70	70	50	50	—	30	30	40	30
Helena, Mont	—	220	200	190	—	—	150	—	—	—	—	60	—	—	—	140	—	—	—	—	—	—	90	—	—	50	—	—	—	<10
Omaha, Nebr	—	—	80	—	—	310	—	190	—	110	—	—	270	—	150	—	190	—	—	110	—	70	—	50	—	—	50	—	30	—
Manchester, N. H	—	—	90	—	—	—	60	—	—	50	—	—	—	40	—	—	—	—	—	—	30	—	—	—	—	—	—	10	—	—
Trenton, N. J	—	70	—	—	—	—	—	—	40	—	—	—	—	20	—	—	10	—	—	—	40	—	—	—	—	—	—	<10	—	—
Albuquerque, N. Mex	—	—	30	10	—	—	50	—	—	—	50	—	40	—	—	—	—	—	—	—	50	—	—	—	<10	—	—	30	—	—
Buffalo, N. Y	—	—	—	—	—	—	100	—	—	—	—	—	—	—	10	—	—	—	—	—	—	10	10	—	—	—	<10	<10	—	—
New York, N. Y	110	70	60	—	—	—	80	80	70	60	60	—	40	40	40	—	—	—	—	20	10	20	—	—	—	—	10	10	<10	10
Syracuse, N. Y	—	—	50	—	—	—	80	—	—	60	—	—	—	10	—	—	—	—	—	—	10	—	—	10	—	—	—	<10	—	<10
Charlotte, N. C	—	—	30	—	—	—	20	—	—	20	—	—	—	10	—	—	10	—	—	—	20	—	<10	—	—	—	10	—	—	—
Minot, N. Dak	—	—	—	—	—	—	—	—	—	—	—	—	—	—	50	—	—	—	—	—	20	—	—	60	—	—	20	—	<10	—
Cincinnati, Ohio	—	—	90	—	—	—	—	—	110	—	—	—	—	—	—	—	80	—	—	—	—	—	—	50	—	—	—	70	—	—
Cleveland, Ohio	—	—	100	—	—	—	—	—	—	80	—	—	—	30	—	—	50	—	—	—	40	—	—	30	—	—	—	<10	—	—
Oklahoma City, Okla	—	80	—	—	—	—	250	—	300	—	—	—	230	—	—	180	—	—	—	140	—	80	—	—	—	—	80	—	—	70
Portland, Oreg	300	—	—	—	—	240	—	—	—	160	—	—	—	—	—	10	—	—	—	220	—	—	—	90	—	—	—	—	—	—
Philadelphia, Pa	—	—	60	—	—	50	—	—	—	50	—	—	—	40	—	—	40	—	—	—	10	—	—	30	—	—	—	10	—	—
Pittsburgh, Pa	—	—	60	—	—	—	—	—	40	50	—	—	—	40	—	—	40	—	—	—	30	—	—	—	—	—	—	<10	—	—
San Juan, P. R	—	—	<10	—	—	—	10	—	—	<10	—	—	—	40	—	—	10	—	—	—	30	—	—	50	—	—	—	40	—	—
Providence, R. I	—	—	80	—	—	—	70	—	—	70	—	—	—	40	—	—	—	—	—	—	30	—	—	30	—	—	—	<10	—	—
Charleston, S. C	—	—	40	—	—	20	—	20	—	10	—	—	10	—	—	—	10	—	—	<10	—	30	—	10	—	—	10	—	10	—
Chattanooga, Tenn	—	—	60	—	—	—	20	—	—	40	—	—	—	20	—	—	40	—	—	—	30	—	—	30	—	—	—	40	—	—
Memphis, Tenn	—	50	—	—	—	—	60	—	150	—	—	—	—	100	—	70	—	—	—	—	70	—	—	80	—	—	—	50	—	70
Austin, Tex	40	30	30	—	60	90	70	110	70	80	60	100	50	80	40	50	—	—	—	30	40	—	—	30	40	—	50	50	80	100
Dallas, Tex	—	40	—	—	—	—	—	—	250	—	—	—	—	130	—	—	100	—	—	—	70	—	—	60	—	—	—	40	—	—
Salt Lake City, Utah	—	140	—	—	—	100	—	120	—	100	—	—	80	110	—	30	—	—	—	<10	—	20	<10	—	—	—	—	—	—	—
Burlington, Vt	—	—	90	—	—	90	—	—	—	70	—	—	—	20	—	—	—	—	—	—	—	30	—	10	—	—	<10	—	—	—
Norfolk, Va	—	—	60	—	—	—	40	—	—	30	—	—	—	20	—	—	30	—	—	—	40	—	—	30	—	—	<10	20	—	—
Seattle, Wash	290	—	200	270	—	110	120	120	140	100	120	—	100	140	190	150	140	190	—	90	90	—	80	50	40	—	30	30	30	10
Spokane, Wash	—	—	120	—	—	150	—	—	—	—	70	—	—	70	50	—	—	—	—	—	—	40	—	—	—	—	<10	—	—	<10
Charleston, W. Va	—	—	—	50	—	—	40	—	—	30	—	—	—	20	—	—	—	—	—	—	10	—	—	—	—	—	—	<10	—	—
Milwaukee, Wis	130	150	140	130	150	130	140	—	110	—	—	100	—	90	—	40	—	—	—	—	30	—	10	—	—	—	—	10	—	10
Laramie, Wyo	—	—	10	—	—	—	20	—	—	30	—	—	—	30	—	—	20	—	—	—	80	—	—	—	—	—	—	<10	—	—

To provide quick assessement of iodine–131 contamination, sampling schedules for all of the regular stations for monitoring fresh pasteurized milk have been accelerated. The samples are air shipped to the Radiological Health Laboratories for analysis. The results are phoned daily to the PHS Radiation Surveillance Center in Washington, D.C. Daily results are, in turn, reported to the State Health Departments so that they are continuously aware of their local situations.

Beginning November 1, 1961, the following sampling schedule became effective:

(a) Daily sampling at
Chicago, Ill.
New Orleans, La.
St. Louis, Mo.
New York, N.Y.
Austin, Tex.
Seattle, Wash.

(b) Three samples per week at
Palmer, Alaska
Sacramento, Calif.
Denver, Colo.
Washington, D.C.
Tampa, Fla.
Atlanta, Ga.
Wichita, Kans.
Jackson, Miss.
Pascagoula, Miss.
Omaha, Neb.
Charleston, S.C.
Salt Lake City, Utah
Milwaukee, Wis.

(c) Two samples per week at remainder of the stations.

Table 2 presents the iodine–131 results of individual samples taken during November 1961. The results are corrected to the date the sample was collected. These samples are composited on a weekly basis for determination of strontium–89, strontium–90, and stable calcium, and will be reported in the monthly summaries.

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SECTION IV. — WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

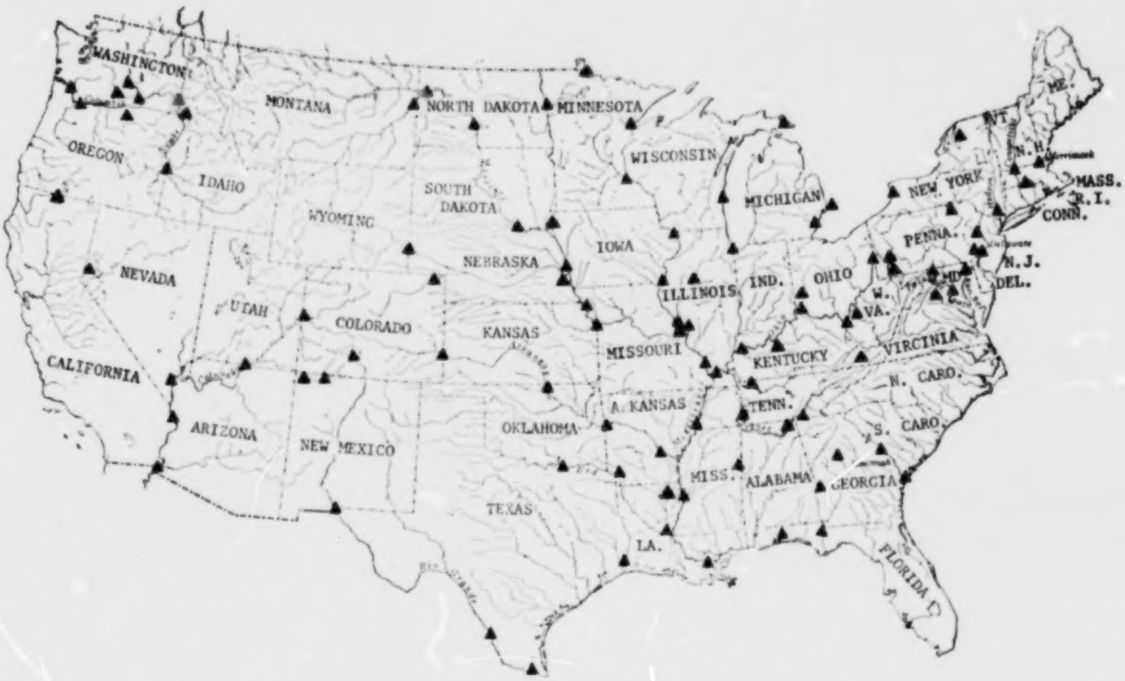
The National Water Quality Network operates under the provision of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and Local agencies, and industrial organizations commenced operations in October, 1957. As of December 1, 1961, there were 97 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from manmade sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the USSR has resulted in an increase in radioactivity of surface waters. Preliminary evidence obtained during October, 1961 indicates a 5- to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, North Eastern, and Eastern United States. The greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly


WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WYOMING
NEVADA
CALIFORNIA
UTAH
COLORADO
NEBRASKA
KANSAS
IOWA
WISCONSIN
MICHIGAN
ILLINOIS
IND.
OHIO
MISSOURI
KENTUCKY
W. VA.
VIRGINIA
N. CARO.
TENN.
A. KANSAS
OKLAHOMA
ARIZONA
NEW MEXICO
TEXAS
LA.
MISS.
ALABAMA
GEORGIA
S. CARO.
FLORIDA
PENNA.
NEW YORK
N.J.
DEL.
MD.
CONN.
R.I.
MASS.
N.H.
VT.
ME.

As of November 29, 1961

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

samples. Alpha determinations were reported generally on composites of more than one weekly sample.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely from all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each had one gross alpha determination per month.

The following changes were instituted on September 1, 1961, following resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease.)
2. Beginning with samples collected October 1, 1961, strontium–90 determinations are to be made on a three months composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in μμc/liter]

Station	Quarter ending June 30, 1961	July 1961					
		Beta activity			Alpha activity		
	Strontium-90	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.2	0	0	0	0	1	1
Animas River: Cedar Hill, N. Mex	[*] —	8	4	12	2	3	5
Apalachicola River: Chattahoochee, Fla	—	0	2	2	0	0	0
Arkansas River:							
Coolidge, Kans	—	52	0	52	80	35	115
Ponca City, Okla	0.7	22	0	22	7	7	14
Pendleton Ferry, Ark	—	23	1	24	14	4	18
Big Sioux River: Sioux Falls, S. Dak	—	1	4	5	0	2	2
Chattahoochie River:							
Atlanta, Ga	0.3	—	—	—	—	—	—
Columbus, Ga	—	0	0	0	1	1	2
Colorado River:							
Loma, Colo	—	16	38	54	1	16	17
Page, Ariz	2.3	153	27	180	80	8	88
Boulder City, Nev	—	0	21	21	0	8	8
Yuma, Ariz	—	0	0	0	1	9	10
Columbia River:							
Pasco, Wash	—	13	115	128	<1	<1	1
Bonneville Dam, Oreg	—	9	76	85	0	1	1
Clatskanie, Oreg	1.1	21	54	75	0	0	0
McNary Dam, Oreg	—	8	64	72	0	<1	<1
Connecticut River: Northfield, Mass	—	0	6	6	0	0	0
Delaware River:							
Martins Creek, Pa	0.4	—	—	—	—	—	—
Philadelphia, Pa	—	5	6	11	0	0	0
Great Lakes:							
Detroit, Mich	—	0	0	0	2	0	2
Port Huron, Mich	—	0	0	0	0	0	0
Milwaukee, Wis	0.3	—	—	—	—	—	—
Sault St. Marie, Mich	—	0	3	3	0	1	1
Duluth, Minn	—	0	3	3	0	0	0
Hudson River: Poughkeepsie, N. Y	0.5	0	0	0	0	0	0
Illinois River: Peoria, Ill	—	5	0	5	1	2	3
Klamath River: Copeo, Oreg	0.3	0	0	0	0	0	0
Little Miami River: Cincinnati, Ohio	—	0	<1	<1	1	1	2
Mississippi River:							
Dubuque, Iowa	—	0	0	0	0	4	4
Burlington, Iowa	—	3	11	14	1	0	1
E. St. Louis, Ill	0.5	7	12	19	0	1	1
Cape Girardeau, Mo	—	37	0	37	10	1	11
West Memphis, Ark	—	4	0	4	—	—	—
Delta, La	—	35	22	57	16	0	16
New Orleans, La	0.6	—	—	—	—	—	—
Missouri River:							
Bismarck, N. Dak	0.6	—	—	—	—	—	—
Omaha, Nebr	0.7	—	—	—	—	—	—
St. Joseph, Mo	—	62	0	62	25	3	28
St. Louis, Mo	—	41	16	57	12	1	13
Monongahela River: Pittsburgh, Pa	—	0	0	0	0	1	1
Ohio River:							
East Liverpool, Ohio	—	0	0	0	0	0	0
Huntington, W. Va	—	0	2	2	1	0	1
Louisville, Ky	—	4	2	6	0	1	1
Evansville, Ind	—	0	3	3	1	1	2
Cairo, Ill	—	5	8	13	0	1	1
Potomac River: Williamsport, Md	0.8	—	—	—	—	—	—
Red River, North: Grand Forks, N. Dak	1.5	—	—	—	—	—	—
Red River, South:							
Index, Ark	—	1	0	1	2	3	5
Denison, Tex	—	0	0	0	0	1	1
Rio Grande River:							
Alamosa, Colo	—	3	23	26	0	2	2
El Paso, Tex	—	6	14	20	2	2	4
Brownsville, Tex	0.3	0	0	0	—	—	—
Roanoke River: John H. Kerr Reservoir and Dam, Va	—	2	<1	2	0	0	0
Sabine River: Ruliff, Tex	0.8	3	7	16	1	1	2
St. Lawrence River: Massena, N. Y	—	0	0	0	0	2	2
Schuylkill River: Philadelphia, Pa	—	6	7	13	0	0	0
Savannah River:							
Port Wentworth, Ga	0.5	2	7	9	1	0	1
North Augusta, S. C	0.8	0	0	0	0	0	0
Snake River: Wawawai, Wash	—	1	7	8	0	1	1
South Platte River: Julesburg, Colo	—	0	131	131	0	124	124
Susquehanna River: Sayre, Pa	—	0	4	4	0	0	0
Tennessee River:							
Chattanooga, Tenn	—	0	58	58	0	0	0
Bridgeport, Ala	0.9	4	46	50	0	0	0
Yakima River: Richland, Wash	—	1	5	6	0	3	3
Yellowstone River: Sidney, Mont	0.8	35	12	47	12	3	15

[*] Dash denotes no sample received or no determinations made.

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All data reported in table 1 represent the average of all information available for the period indicated. Reported strontium-90 data are the results of determinations on three-month composite samples for a quarter ending in the month shown. The data were determined on analytical schedules in effect till September 1, 1961.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957-58, 1958-59, 1959-60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," J. AWWA *51*, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," J. AWWA *52*, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

SECTION V. — OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following tables are within the variance anticipated due to differences in normal background and in instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, OCTOBER 1961

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Anchorage	Alaska	0.01	Pascagoula	Mississippi	0.01
Fairbanks	Alaska	0.01	Helena	Montana	0.03
Juneau	Alaska	0.01	Trenton	New Jersey	0.02
Kodiak	Alaska	0.01	Sante Fe	New Mexico	0.04
Phoenix	Arizona	0.02	Albany	New York	0.03
Little Rock	Arkansas	0.01	Gastonia	North Carolina	0.02
Berkeley	California	0.01	Bismark	North Dakota	0.01
Los Angeles	California	0.01	Columbus	Ohio	0.01
Denver	Colorado	0.02	Oklahoma City	Oklahoma	0.01
Hartford	Connecticut	0.01	Ponca City	Oklahoma	0.04
Washington	District of Columbia	0.02	Portland	Oregon	0.02
Jacksonville	Florida	0.01	Harrisburg	Pennsylvania	0.01
Miami	Florida	0.02	San Juan	Puerto Rico	0.01
Atlanta	Georgia	0.02	Providence	Rhode Island	0.02
Honolulu	Hawaii	0.03	Columbia	South Carolina	0.02
Boise	Idaho	0.02	Pierre	South Dakota	0.02
Springfield	Illinois	0.01	Nashville	Tennessee	0.01
Indianapolis	Indiana	0.01	Austin	Texas	0.01
Iowa City	Iowa	0.03	El Paso	Texas	0.02
Topeka	Kansas	0.02	Salt Lake City	Utah	0.02
Frankfort	Kentucky	0.01	Richmond	Virginia	0.01
New Orleans	Louisiana	0.01	Seattle	Washington	0.01
Baltimore	Maryland	0.01	Madison	Wisconsin	0.01
Lawrence	Massachusetts	0.02	Cheyenne	Wyoming	0.02
Lansing	Michigan	0.02	Jefferson City	Missouri	0.01
Minneapolis	Minnesota	0.01			
Jackson	Mississippi	0.01	Network average		0.02

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Cesium-137 Levels in Humans

Walter Reed Army Institute of Research, Washington, D.C., and
U.S. Army Medical Research Unit, Landstuhl, Germany

The whole body counting facilities at the Walter Reed Army Institute of Research (WRAIR), Washington, D.C., and the Medical Research Unit, Landstuhl, Germany, have continued their program for measuring the levels of cesium-137 in people. A description of each facility and previous data were summarized in *Radiological Health Data,* Volume II, Number 4; subsequent data appeared in Volume II, Numbers 7 and 10.

This report presents results from Germany for the period June through August 1961, and from Walter Reed for the third quarter of 1961. The Landstuhl data are listed by month in table 1 and the Walter Reed data are listed by geographic area in tables 2 and 3.

TABLE 1.—ASSAYS PERFORMED AT THE U.S. ARMY MEDICAL RESEARCH UNIT, LANDSTUHL, GERMANY

Date	Subjects residing in	Number of subjects	μμc Cs^{137}/gmK (average)
June 1961	West Germany	291	33
July 1961	West Germany	450	32
August 1961	West Germany	260	37

TABLE 2.—ASSAYS PERFORMED AT THE WALTER REED ARMY INSTITUTE OF RESEARCH, THIRD QUARTER, 1961

Geographic area	Number of subjects	μμc Cs^{137}/gm K (average)
Europe	5	41
Far East	2	31
Pacific Islands	4	20
United States	61	22

TABLE 3.—ASSAYS OF INDIVIDUALS RESIDING WITHIN THE UNITED STATES PERFORMED AT WRAIR, THIRD QUARTER, 1961

State	Number of subjects	μμc Cs^{137}/gm K (average)
Alabama	1	0
Arizona	2	3
California	7	23
Colorado	1	0
District of Columbia	7	24
Florida	1	62
Georgia	1	28
Kansas	2	33
Maryland	4	25
Massachusetts	2	1
Michigan	1	28
New Jersey	1	19
North Carolina	2	32
Ohio	1	0
Oklahoma	2	19
Pennsylvania	4	21
Rhode Island	5	28
Texas	9	21
Virginia	7	21
Washington	1	29

TABLE 4.—SUMMARY OF TABLES 1 and 2—THIRD QUARTER, 1961

Geographic area	Number subjects	μμc Cs^{137}/gm K (average)	Percent MPC[1]
Europe	5	41	0.21
Far East	2	31	0.16
Pacific Island	4	20	0.10
United States	61	22	0.11
West Germany	1001	[2] 34	0.17

[1] *Radiological Health Data,* Volume II, Number 4, pages 193 and 194.
[2] Values represent determinations for June through August 1961.

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Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission transmits to the Public Health Service quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data,* Volume I, Numbers 8 and 9; and Volume II, Numbers 1 through 12. Summaries follow for Brookhaven National Laboratory, Mound Laboratory, National Reactor Testing Station, Oak Ridge Area, and Paducah Plant for the first and second quarters of 1961.

The measured concentrations of radioactive substances in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurements (NCRP). For the general population, the applicable MPC's are one-tenth of the occupational values for continuous exposure as given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, then the sum of all the percent values should not exceed 100%.

In the following reports, the use of terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic analyses necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's when reported by the laboratory.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radioactive substance	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	Cerium-144	10,000	300
2	Cesium-137	20,000	500
3	Cobalt-60	30,000	300
4	Iodine-131	2,000	300
5	Plutonium-239	5,000	0.06
6	Polonium-210	700	20
7	Ruthenium-106—rhodium-106	10,000	200
8	Strontium-90	100	10
9	Thorium-234—protactinium-234	20,000	1,000
10	Uranium-natural	20,000	2
11	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, At^{211}, Ra^{223}, Ra^{224}, Ra^{226}, Ac^{227}, Ra^{228}, Th^{230}, Pa^{231}, Th^{232}, and Th-nat are not present [1]	3,000	—
12	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present [1]	600	—
13	If Ra^{226}, Ra^{228} are not present [1]	100	—
14	Mixture of unidentified nuclides	10	0.04
15	If α emitters and Ac^{227} are not present [1]	—	1.0
16	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present [1]	—	10
17	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present [1]	—	100

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of the concentration of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

Brookhaven National Laboratory

Associated Universities, Inc., Upton, New York —Issued October 1961

Previous coverage in *Radiological Health Data*

Period covered:	Issue:
1959 and first quarter 1960	Volume I, Number 9
Second quarter 1960	Volume II, Number 2
Third and fourth quarters 1960	Volume II, Number 6

The following report summarizes the environmental levels of radioactivity at the Brookhaven National Laboratory (BNL) for the first and second quarters of 1961.

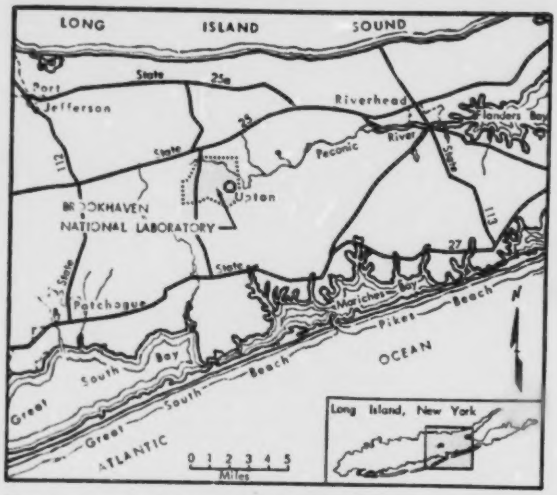
LONG ISLAND SOUND
State 25a
Port Jefferson
Riverhead
Flanders Bay
25
State
Peconic River
State 113
112
Upton
BROOKHAVEN NATIONAL LABORATORY
27
State
State
Patchogue
Moriches Bay
Pikes Beach
N
OCEAN
South Bay
Great
Great South Beach
ATLANTIC
0 1 2 3 4 5
Miles
Long Island, New York

FIGURE 1.—BROOKHAVEN NATIONAL LABORATORY AND SURROUNDING AREA

Laboratory operations affect the levels of radiation in the vicinity of BNL in two ways: (1) by the discharge of coolant air from the graphite research reactor, and (2) by the discharge of low level radioactive liquid wastes into a small stream that forms one of the headwaters of the Peconic River.

Air Monitoring

The radioactivity in the discharged coolant air is almost entirely that of argon–41, a beta-gamma emitter. Because the most critical exposure to argon–41 is that of external gamma, the monitoring is performed by measuring the dose-rate in milliroentgens per week (mr/wk) rather than the concentration in air. The environmental maximum permissible dose recommended by NCRP is 0.5 r/yr (10 mr/wk) above natural background, averaged over a one-year period.

Table 2 presents the average dose rate measured at each of the four monitoring stations, three of which are on the site boundary.

TABLE 2.—GAMMA LEVELS ON SITE BOUNDARY DUE TO COOLANT AIR EFFLUENT

[Average dose rates in mr/week]

Period—1961	North gate (680 meters inside boundary)	Southwest perimeter	Southeast perimeter	Northeast perimeter
First quarter	0.79	1.11	4.17	1.17
Second quarter	2.04	1.21	1.22	2.49

Water Monitoring

The BNL liquid waste effluent is monitored for gross beta concentrations at the site boundary. Table 3 presents the average concentration together with the total activity released as determined by using known effluent flow rates.

TABLE 3.—GROSS BETA ACTIVITY IN LIQUID WASTE EFFLUENT

Period—1961	Average effluent flow rate (million gallons/day	Average beta concentration (μμc/liter)	Total beta activity millicuries
First quarter	0.445	230	35.2
Second quarter	1.478	120	61.2

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Mound Laboratory

Monsanto Chemical Company
Miamisburg, Ohio
—Issued September 1961

Previous Coverage in *Radiological Health Data*

Period covered:	Issue:
1959 and first quarter 1960	Volume I, Number 8
Second and third quarters 1960	Volume II, Number 3
Fourth quarter 1960	Volume II, Number 8

Environmental levels of radioactivity at the Mound Laboratory for the first and second quarters, 1961 are summarized in the following report. During that time, no radioactive materials were used which contributed any measurable penetrating radiation such as gamma or hard beta to the environment. Polonium, plutonium, and tritium are possible air contaminants, and polonium and tritium are possible river water contaminants.

Air Monitoring

A continuous air monitor for measurement of tritium and particulate air sampling equipment for measurement of alpha activity mounted on a one-ton panel truck are used in the routine monitoring of the environmental air.

Figures 2 and 3 show 95 locations up to 20 miles from the laboratory at which air samples are taken. The selection of sampling sites depends on the wind direction on the days that samples are collected. Samples are collected downwind from the plant according to routes drawn up for the different wind directions. It is quite likely that not all sites will be sampled during any one quarter.

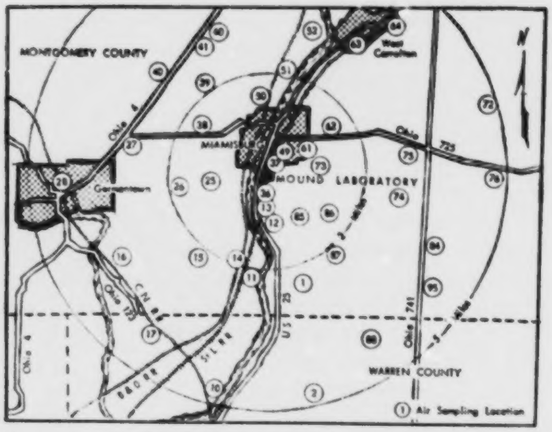
MONTGOMERY COUNTY
Ohio 4
West Carrollton
Germantown
MIAMISBURG
MOUND LABORATORY
Ohio 725
Ohio 741
U.S. 25
WARREN COUNTY
N
Air Sampling Location

FIGURE 2.—CLOSE-IN AIR SAMPLING LOCATIONS, MOUND LABORATORY

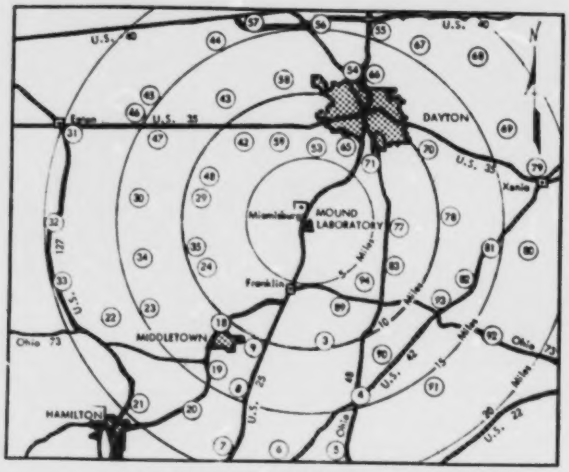
U.S. 40
U.S. 35
N
DAYTON
Eaton
Xenia
Miamisburg
MOUND LABORATORY
5 Miles
Franklin
MIDDLETOWN
Ohio 73
U.S. 127
U.S. 25
U.S. 42
U.S. 22
10 Miles
15 Miles
20 Miles
HAMILTON

FIGURE 3.—DISTANT AIR SAMPLING LOCATIONS, MOUND LABORATORY

A total of 231 samples were taken for determination of tritium in air during the first and second quarters, 1961. In all cases the tritium concentration was below the minimum level of detection.

Monitoring for possible polonium and plutonium released to the environment is accomplished by determination of long-lived gross alpha on filter paper samples. Counting was done in a low background proportional counter after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. The average alpha concentrations in air at different distances from the Laboratory are given in table 4.

If all the alpha activity were assumed to be polonium it would be about 0.05% of the MPC for polonium as given in table 1. However, polonium effluent stack monitoring indicated

Table 4.—GROSS ALPHA ACTIVITY IN AIR

Sampling location zone (distance in miles from laboratory)	First quarter 1961		Second quarter 1961	
	No. of samples	Average concentration ($\mu\mu c/m^3$)	No. of samples	Average concentration ($\mu\mu c/m^3$)
0—2	24	0.0073	19	0.0055
2—5	41	0.0074	35	0.0079
5—10	26	0.0064	17	0.0057
10—15	28	0.0106	24	0.0092
15—20	35	0.0142	29	0.0192
All samples	154	0.0093	124	0.0101

that no detectable polonium should be found in the environment due to the operations of Mound Laboratory.

If the alpha activity were assumed to be all plutonium, it would amount to a much more significant 16% of the MPC for plutonium. Again the stack monitoring results are quite meaningful. The average concentration of plutonium in the air discharged from the plutonium stack was well within environmental limits. For this reason, and the fact that the air is discharged to the environment from the 200 foot stack at high velocity yielding appreciable dilution, it is seen that the plutonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere. It is also pointed out that the natural alpha concentration in air in southwestern Ohio is in the range of and frequently exceeds the MPC for plutonium.

Water Monitoring

Liquid radioactive waste materials from polonium work at the laboratory are processed in a special waste disposal plant designed to reduce radioactivity to a concentration level at which it may be discharged to the Great Miami River. Liquid waste from the plutonium work is small in volume. It is handled separately as a packaged waste and is not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid wastes from this work, also small in volume are treated separately (diluted with water when necessary) to assure that the radioactive content is within the maximum permissible concentration for discharge to the Great Miami River.

Water samples are collected weekly from a drainage ditch and five locations along the Great Miami River as shown in figure 4. The drainage ditch carries away all storm sewer water and liquid tritium wastes from the plant site. Sampling location number 2 is located at the point of discharge of the laboratory effluent to the Great Miami River. Number 6 is five miles downstream from the effluent discharge. Additional single downstream samples were collected at five locations (beyond the limits of the map in figure 4) during the first quarter.

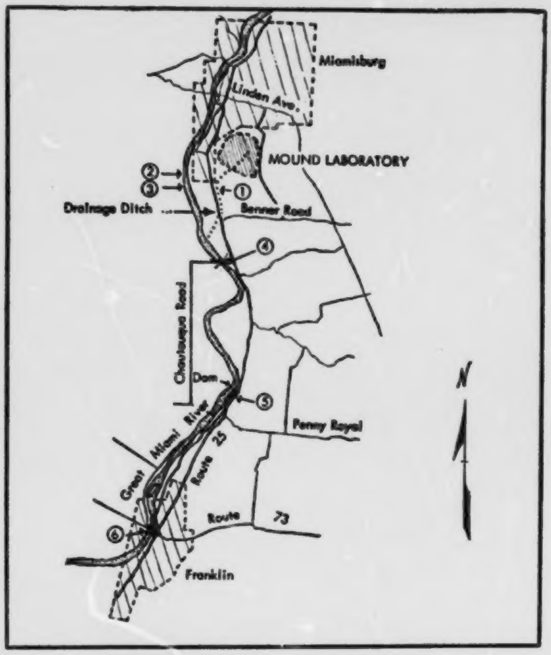

Figure 4.—WATER SAMPLING LOCATIONS IN GREAT MIAMI RIVER, MOUND LABORATORY

All of the river samples are analyzed for polonium concentration. The drainage ditch samples and some of the river samples are analyzed for tritium. Average concentrations of polonium and tritium are given in table 5.

Table 5.—OFF-SITE WATER MONITORING FOR POLONIUM AND TRITIUM

[Average concentrations in μμc/liter]

Station code No. (see figure 4)	First quarter 1961				Second quarter 1961			
	Tritium		Polonium		Tritium		Polonium	
	No. of samples	Concentration	No. of samples	Concentration	No. of samples	Concentration	No. of samples	Concentration
1	9	222,000	0	....	13	1,230,000	0	....
2	7	ND[b]	9	9.6	13	692,000	13	8.59
3	0	....	9	1.21	0	....	13	1.66
4	7	ND	9	0.20	13	760,000	13	1.39
5	0	....	9	1.60	0	....	13	1.53
6	0	....	9	1.80	0	....	13	1.53
None[a]	0	....	5	ND	0	....	0	....

[a] Single samples were collected at five downstream locations between Franklin and Elizabethtown, Ohio.
[b] ND = No detectable activity.

National Reactor Testing Station

Health and Safety Division

Atomic Energy Commission
Idaho Falls, Idaho

First and Second Quarters 1961

—Issued September 1961

Previous coverage in *Radiological Health Data*

Period covered:	Issue:
1959 and first quarter 1960	Volume I, Number 9
Second Quarter 1960	Volume II, Number 2
Third and fourth quarters 1960	Volume II, Number 5

Descriptions and discussions of the monitoring network procedures have been adequately presented in the earlier issues referred to above. Certain modifications for increased efficiency and coverage were initiated in January, 1961. Figure 5 shows the current sampling locations. The monitoring network improvements were as follows:

a. Revision of milk sampling station locations to obtain samples from additional dairy herds on the periphery of the NRTS.
b. Additional off-site underground water sampling stations to provide control samples from populated areas upstream on water gradient.
c. Additional air monitoring coverage to the southwest of the NRTS.
d. Addition of 14 area monitoring badges at off-site air monitoring locations to replace badges originally located at various points within the Station.

The SL–1 accident on January 3, 1961, did not release sufficient quantities of radioactivity to approach the established RCG or RPG levels as recommended by the Federal Radiation Council. Increased radioactivity was observed on air filters located at Atomic City and Aberdeen, Idaho. Milk samples collected from dairy herds between Atomic City and Springfield, Idaho indicated possible iodine–131 at the detection levels of 200 μμc/liter. However, the levels detected in all cases were considerably below the established guide values.

Table 6 presents the environmental monitoring data for the first and second quarters for 1961 together with averages for the 1960 calendar year.

30<

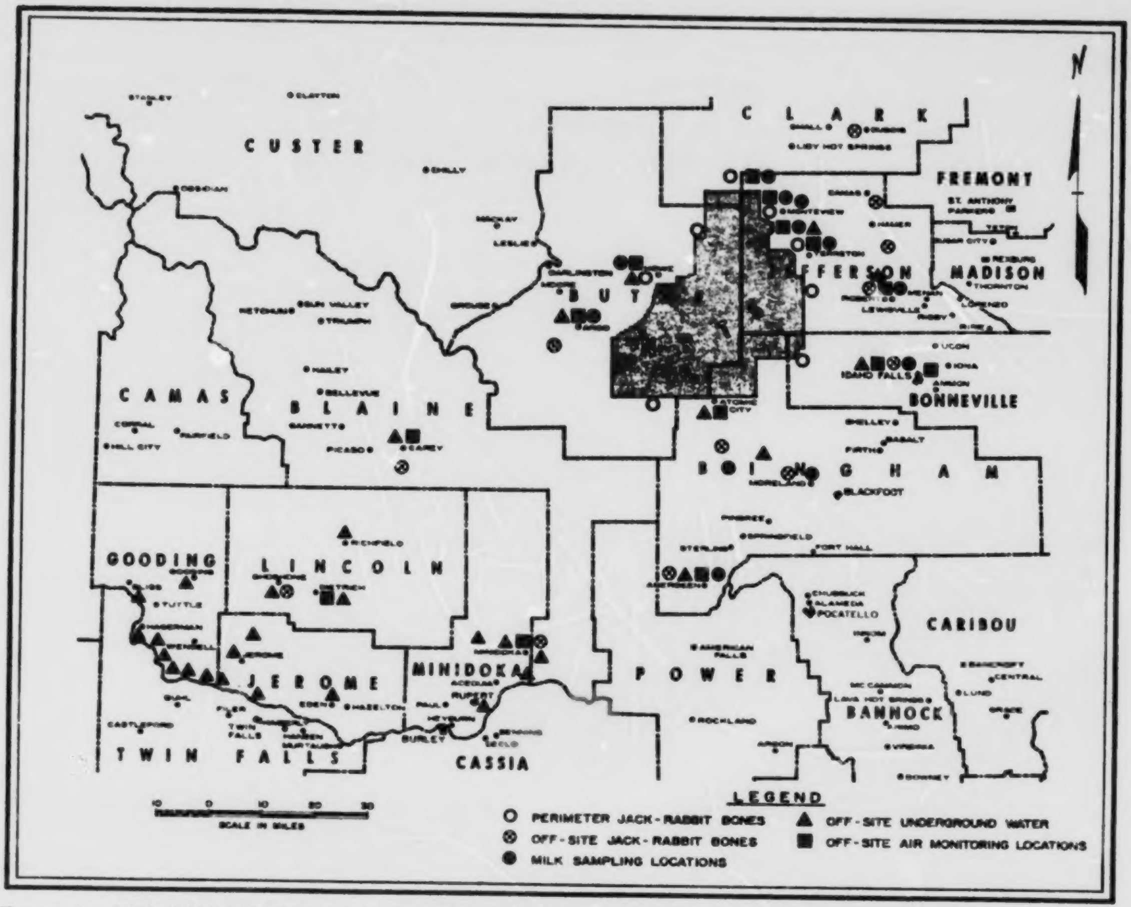
N
CUSTER
CLARK
FREMONT
JEFFERSON
MADISON
BUTTE
CAMAS
BLAINE
BONNEVILLE
BINGHAM
GOODING
LINCOLN
JEROME
MINIDOKA
POWER
CARIBOU
BANNOCK
TWIN FALLS
CASSIA
IDAHO FALLS
BLACKFOOT
POCATELLO
10 0 10 20 30
SCALE IN MILES
LEGEND
○ PERIMETER JACK-RABBIT BONES
⊗ OFF-SITE JACK-RABBIT BONES
● MILK SAMPLING LOCATIONS
▲ OFF-SITE UNDERGROUND WATER
■ OFF-SITE AIR MONITORING LOCATIONS

FIGURE 5.—ENVIRONMENTAL MONITORING STATIONS, NATIONAL REACTOR TESTING STATION

TABLE 6.—ENVIRONMENTAL MONITORING PROGRAM DATA

Type of sample and units	Calendar year 1960		First quarter 1961		Second quarter 1961	
	Number of samples	Average activity	Number of samples	Average activity	Number of samples	Average activity
Off-site underground water ($\mu\mu c$/liter)	151	α: < 3.1 β: <150	56	α: < 3 β: <150	30	α: < 3 β: <150
On-site underground water ($\mu\mu c$/liter)	779	α: < 3.1 β: <150	216	α: < 3 β: <160	172	α: < 3 β: <150
Off-site air filters ($\mu\mu c/m^3$)	379	β: < 1.4	189	β: 1.6	123	β: 1
Perimeter jack rabbit bones[1] ($\mu\mu c$ Sr^{90}/g Ca)	45	< 16	13	17	12	14
Off-site jack rabbit bones[1] ($\mu\mu c$ Sr^{90}/g Ca)	68	< 18	25	12	21	8
Off-site milk ($\mu\mu c$ I^{131}/liter)	790	<600	91	200	39	<200
Area monitoring badges (mrem)	897	(Total for year) γ: <160 β: <125	42	(Total for quarter) γ: < 60 β: < 30	28	(Total for quarter) α: < 30 β: < 30

[1] The reporting of strontium-90 in jackrabbit bones lags the collection of the samples by one-quarter year.

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Oak Ridge Area

Union Carbide Nuclear Company
Oak Ridge, Tennessee

First and Second Quarters 1961
—Issued October 1961

Previous coverage of Oak Ridge Area (under the title—Oak Ridge National Laboratory) in *Radiological Health Data* is as follows:

Periods covered:	Issue:
1959 and 1st quarter 1960	Volume I, No. 9
2nd and 3rd quarters 1960	Volume II, No. 3
4th quarter 1960	Volume II, No. 7

This report presents first and second quarter 1961 data on the environmental levels of radioactivity for the Oak Ridge Area. As shown in figure 6, K–25 Area, X–10 Area, and Y–12 Area are located within the large AEC controlled Oak Ridge Area. The Oak Ridge National Laboratory (ORNL) is located within the X–10 Area and the Oak Ridge Gaseous Diffusion Plant (ORGDP) is located within the K–25 Area.

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to pits located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

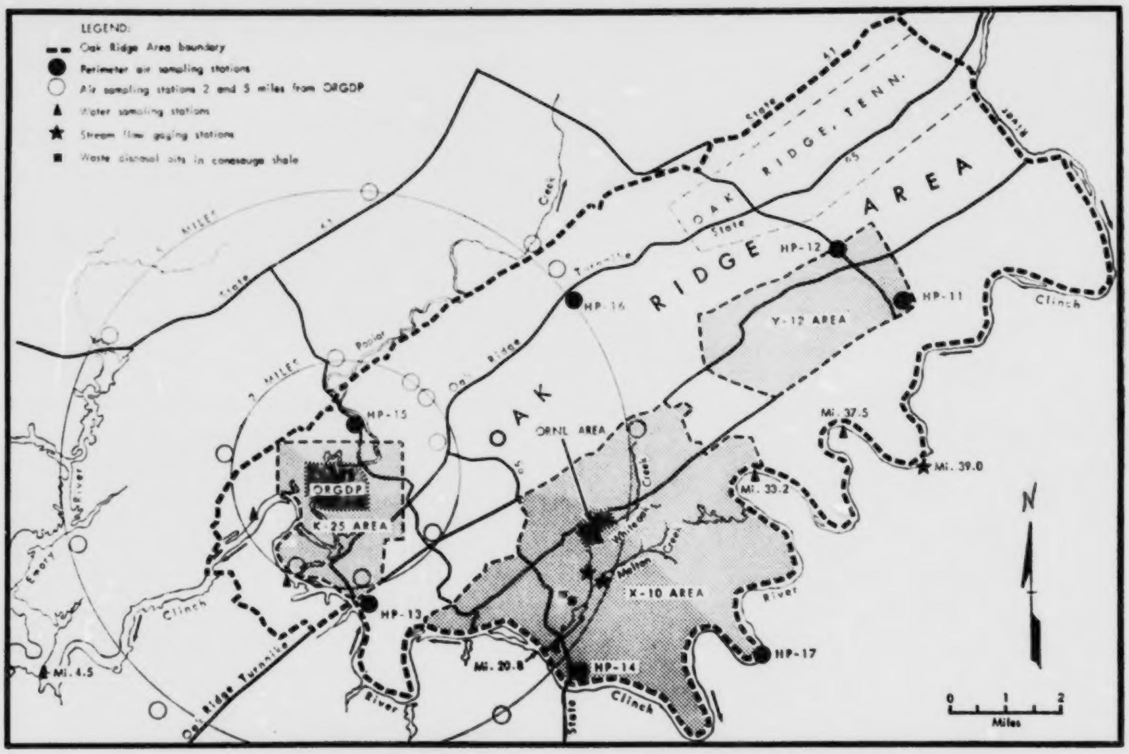
LEGEND:
Oak Ridge Area boundary
Perimeter air sampling stations
Air sampling stations 2 and 5 miles from ORGDP
Water sampling stations
Stream flow gaging stations
Waste disposal pits in conasauga shale
OAK RIDGE, TENN.
OAK RIDGE AREA
State
41
61
5 MILES
2 MILES
Creek
Poplar
Oak Ridge
Turnpike
HP-11
HP-12
HP-13
HP-14
HP-15
HP-16
HP-17
Y-12 AREA
ORNL AREA
ORGDP
K-25 AREA
X-10 AREA
Whiteoak Creek
Melton Creek
Clinch
Clinch River
Emory River
Mi. 4.5
Mi. 20.8
Mi. 33.2
Mi. 37.5
Mi. 39.0
N
0
1
2
Miles
Oak Ridge Turnpike
State

FIGURE 6.—OAK RIDGE AREA ENVIRONMENTAL SAMPLING LOCATIONS

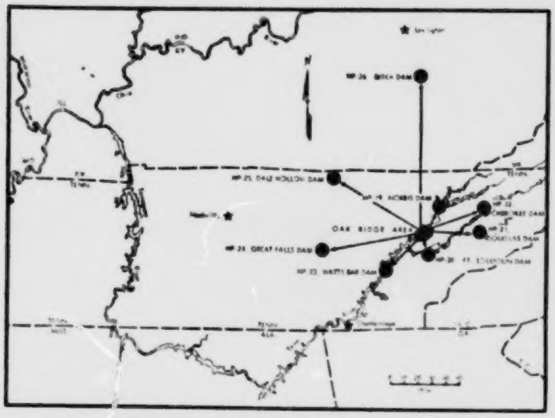

FIGURE 7.--REMOTE AIR MONITORING STATIONS, OAK RIDGE AREA

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

Air Monitoring

Atmospheric contamination by long-lived fission products and fallout occurring in the general environment of eastern Tennessee are monitored by two systems of monitoring stations. One system consists of seven stations which encircle the plant area (Fig. 6) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge Area at distances of from 12 to 120 miles (figure 7). This system provides data to aid in evaluating local conditions and to assist in determining the spread of contamination should a major incident occur. Sampling is carried out by passing air continuously through a filter paper. Average concentrations are tabulated in table 7. The measured uranium concentrations are reported in table 8.

TABLE 7.—LONG-LIVED GROSS BETA CONCENTRATIONS IN AIR

[Average concentrations in $\mu\mu c/m^3$]

Station number (*see figures 6 and 7*)	First quarter 1961		Second quarter 1961	
	Number of samples	Average gross β	Number of samples	Average gross β
Perimeter stations:				
HP-11	13	0.057	14	0.091
HP-12	13	0.088	14	0.163
HP-13	14	0.052	14	0.099
HP-14	14	0.051	14	0.094
HP-15	13	0.065	13	0.138
HP-16	13	0.054	14	0.150
HP-17	13	0.054	14	0.096
All perimeter stations	93	0.060	97	0.119
Remote stations:				
HP-19	13	0.064	14	0.100
HP-20	13	0.054	13	0.099
HP-21	13	0.062	13	0.104
HP-22	14	0.050	14	0.086
HP-23	13	0.052	13	0.097
HP-24	13	0.050	13	0.096
HP-25	13	0.055	13	0.097
HP-26	13	0.053	13	0.086
All remote stations	105	0.055	106	0.095

TABLE 8.—URANIUM CONCENTRATIONS IN AIR NEAR THE OAK RIDGE GASEOUS DIFFUSION PLANT

[Average concentrations in $\mu\mu c/m^3$]

Distance from center of plant	First quarter 1961		Second quarter 1961	
	Number of samples	Uranium concentration	Number of samples	Uranium concentration
2 miles	16	0.041	0	----------
5 miles	16	0.103	16	0.13

Atmospheric contamination by uranium is determined by taking periodic air samples at eight locations on a three-mile radius and eight locations on a five-mile radius from the Oak Ridge Gaseous Diffusion Plant (fig. 6).

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as recommended by the National Committee on Radiation Protection (NCRP). The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Water samples are taken at a number of locations in the Clinch River, beginning at a

Table 9.—CONCENTRATIONS OF MAJOR RADIONUCLIDES IN THE CLINCH RIVER

[Average concentrations in μμc/liter]

Radionuclide	First quarter 1961			Second quarter 1961		
	Location on Clinch River[a]			Location on Clinch River[a]		
	Mi. 37.5 (Upstream)	Mi. 20.8[b] (Outfall)	Mi. 4.5 (Downstream)	Mi. 33.2 (Upstream)	Mi. 20.8[b] (Outfall)	Mi. 4.5 (Downstream)
Sr^{90}	0.5	13	7.8	0.5	6.0	3.7
Ce^{144}	0.1	2.3	0.6	0.4	0.8	0.5
Cs^{137}	ND[c]	5.1	Trace	0.4	5.4	0.9
$Ru^{103-106}$	ND	730	480	ND	670	350
Co^{60}	ND	15	7.2	0.1	12	5
Gross Beta	3.9	1200	670	4.4	1200	400

[a] The location on Clinch River is given in terms of the distance upstream from the Tennessee River. See figure 6.

[b] The concentrations at mi. 20.8 are not measured directly but the values calculated on the basis of levels of waste released and the dilution afforded by the river.

[c] ND—None detected.

point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the United States Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters. The averages are tabulated in tables 9 and 10.

Table 10.—URANIUM CONCENTRATIONS IN THE CLINCH RIVER

[Average concentrations in μμc/liter]

Sampling location	First quarter 1961		Second quarter 1961	
	Number of samples	Uranium concentration	Number of samples	Uranium concentration
Upstream from ORGDP	14	1.1	13	2.3
Downstream from ORGDP	13	1.7	11	3.2

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge Area. Measurements are taken with a Geiger-Mueller tube at a distance of three feet above ground, and the results are tabulated in table 11 in terms of mr/hr.

Table 11.—EXTERNAL GAMMA RADIATION LEVELS

[Average dose rates in mr/hr]

Location	First quarter 1961	Second quarter 1961
Solway gate	0.016	0.014
Y-12 east portal	0.013	0.014
Newcomb Road	0.013	0.014
Gallaher gate	0.017	0.014
White Wing gate	0.014	0.013
Average	0.015	0.014

Paducah Plant

Union Carbide Nuclear Company
Paducah, Kentucky

First and Second Quarters 1961
—Issued September 1961

Previous coverage in *Radiological Health Data:*

Period covered:	Issue:
1959 and first quarter 1960	Volume I, Number 9
Second and third quarters 1960	Volume II, Number 3
Fourth quarter 1960	Volume II, Number 7

The Paducah Plant is a Government owned gaseous diffusion plant operated by Union Carbide Nuclear Company for the Atomic Energy Commission. The gaseous diffusion plant, the associated uranium hexafluoride manufacturing plant, and uranium metal foundry process large quantities of relatively pure uranium

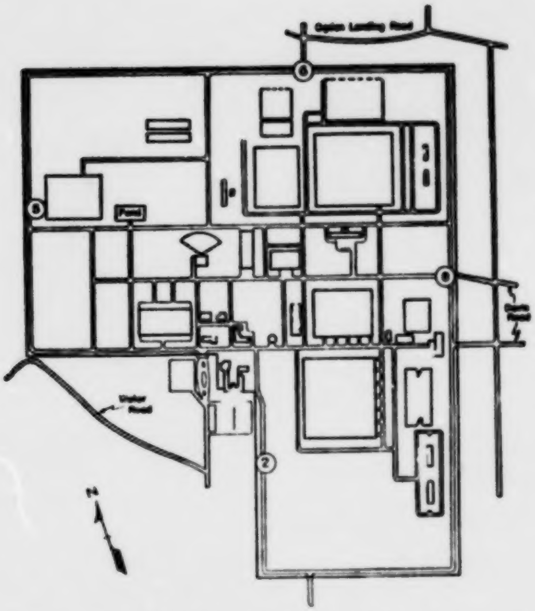

FIGURE 8.—AIR SAMPLING POSITIONS, PADUCAH GASEOUS DIFFUSION PLANT

compounds. The major sources of external penetrating radiation from such materials are the daughter-product isotopes of thorium and protactinium formed by alpha decay and subsequent beta decay of the parent uranium. These isotopes are concentrated in the ash produced during the fluorination process. The element uranium can be a physiological hazard only if it enters the body. The chemical toxicity of the uranium materials processed at the Paducah Plant overshadows any radiation danger from this element, making it a physiological risk comparable to lead, mercury, or other well-known heavy metals.

Uranium is a rather expensive material, and thus represents a great incentive to recover as much as is economically feasible. To protect the population and to maintain a wholesome relationship with neighboring communities and individuals, the air is exhausted through filters, and all effluent waters are discharged at extremely low concentrations of uranium.

Since no recovery process or filtering system is 100 percent effective an environmental monitoring program is used to evaluate the effectiveness of such measures. The Paducah Plant Environmental Monitoring Program consists of a continuing system for sampling air at four stations around the plant perimeter fence, and four off-site stations; and for sampling water at two locations in Big Bayou Creek, and four locations on the Ohio River as shown in figures 8 and 9. Tables 12 and 13 present the air and water monitoring data.

TABLE 12.—RADIOACTIVITY IN AIR

[Average concentrations in $\mu\mu c./m^3$]

Sampling station number	First quarter 1961			Second quarter 1961		
	Number of samples	Uranium	Gross beta	Number of samples	Uranium	Gross beta
On-site:						
2	13	<0.07	<0.29	13	<0.07	0.32
5	13	<0.07	<0.30	13	<0.07	<0.30
6	13	0.12	0.99	13	<0.07	0.90
8	13	<0.07	<0.30	13	<0.07	0.37
Overall	52	<0.07	0.39	52	<0.07	0.46
Off-site:						
South	4	<0.07	<0.30	13	<0.07	<0.30
West	4	<0.07	<0.30	13	<0.07	<0.30
North	4	<0.07	<0.30	13	<0.07	<0.30
East	4	<0.07	<0.30	13	<0.07	<0.30
Overall	16	<0.07	<0.30	52	<0.07	<0.30

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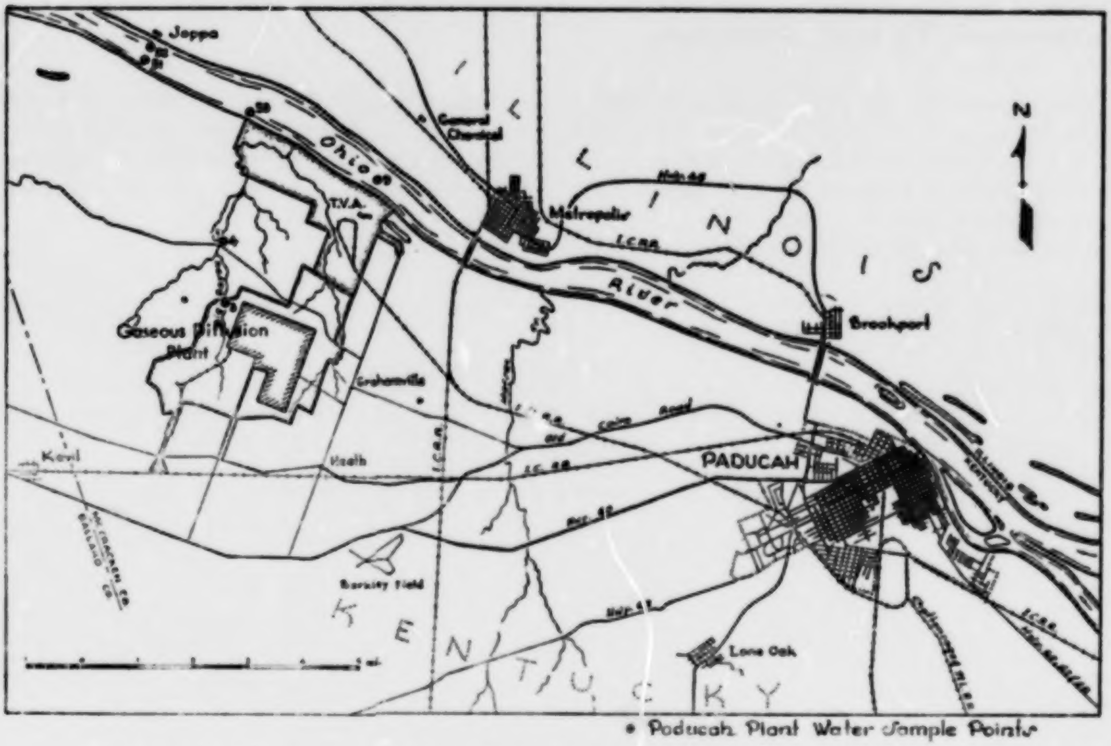
Joppa
General Chemical
Ohio River
T.V.A.
Metropolis
ICRR
Hwy. 45
I L L I N O I S
Brookport
Gaseous Diffusion Plant
Grahamville
Kevil
Heath
PADUCAH
Barkley Field
Lone Oak
K E N T U C K Y
N
• Paducah Plant Water Sample Points

FIGURE 9.—WATER SAMPLING LOCATIONS, PADUCAH GASEOUS DIFFUSION PLANT

TABLE 13.—RADIOACTIVITY IN WATER

[Average concentrations in μμc/liter]

Sampling station number	First quarter 1961			Second quarter 1961		
	Number of samples	Uranium	Gross beta	Number of samples	Uranium	Gross beta
3	13	25	300	13	9	200
4	3	13	100	3	7	400
9	6	1	100	6	1	400
51	6	1	200	6	1	200
52	6	1	100	6	<1	200
53	6	<1	100	6	<1	100

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Announced Nuclear Detonations

Radiological Health Data, Volume II, Numbers 10, 11, and 12 published the dates of the Union of Soviet Socialist Republics and the United States announced nuclear detonations through December 3, 1961. The following table gives information on the subsequent tests reported through January 1, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton) yield; low-intermediate to mean between a nominal and one megaton yield.

Test Number	Location	Date	Size	Type of test
ANNOUNCED U.S. DETONATIONS				
6	Carlsbad, New Mexico	December 10	5 KT	Underground, "Operation Gnome," Plowshare Program.
7	Nevada Test Site	December 13	Low yield	Underground.
8	Nevada Test Site	December 17	Low yield	Underground.
9	Nevada Test Site	December 22	Low yield	Underground.

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MONTHLY REPORT FEBRUARY 1962 VOLUME III, NUMBER 2

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Public Health Service ● Division of Radiological Health

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SECTION I. — AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, it consisted of 45 stations at urban locations operated by State and local health department personnel with 2 of the stations operated by Public Health Service personnel. Following the resumption of nuclear weapons testing in September 1961, the network has been expanded to 62 stations (see figure 1).

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Air is drawn through a cellulose carbon-loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D.C., for a more refined measurement using a thin-window proportional counter.

Table 1 presents the monthly summary report of fission product gross beta concentrations in surface air during November 1961. Table 2 presents the first publication in *Radiological Health Data* of the Radiation Surveillance Network data for gross beta radioactivity of precipitation. Before the resumption of nuclear weapons testing, the values were generally below the levels of accurate determination by present instrumentation.

One continuous precipitation sample is taken for each air sampling period, using locally-made collector funnels having collecting areas of approximately 0.4 square meter. One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the Laboratory and counted by the same method used for analyzing the air samples. The results in table 2 are the summation of the daily results for the month indicated, expressed in micromicrocuries per square meter ($\mu\mu c/m^2$). To determine the average concentration, divide the $\mu\mu c/m^2$ by the amount of rainfall in millimeters. When a "less than" value occurs in the daily results, one-half of the number is used for the monthly summation.

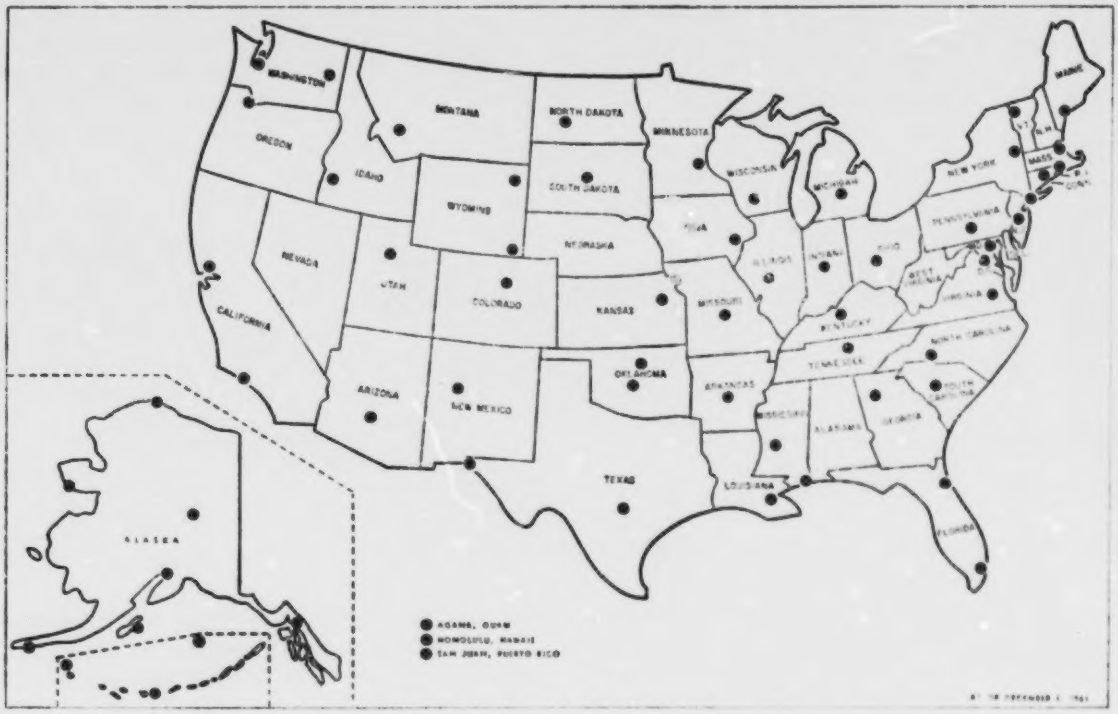
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VT.
N.H.
MAINE
MASS.
R.I.
CONN.
ALASKA
● AGANA, GUAM
● HONOLULU, HAWAII
● SAN JUAN, PUERTO RICO

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR, GROSS BETA DETERMINATIONS, NOVEMBER 1961

Station location		Number samples	Maximum (μμc/m³)	Minimum (μμc/m³)	Average[1] μμc/m³
City	State				
Adak	Alaska	21	5.6	0.10	3.3
Anchorage	Alaska	30	17	0.76	8.0
Attu	Alaska	29	9.2	<0.10	4.9
Cold Bay	Alaska	30	9.3	<0.10	4.4
Fairbanks	Alaska	30	6.8	0.50	3.8
Juneau	Alaska	30	17	0.26	5.6
Kodiak	Alaska	30	13	0.73	5.0
Nome	Alaska	24	22	0.35	4.9
Point Barrow	Alaska	29	9.4	1.5	3.9
St. Paul Island	Alaska	22	10	0.47	4.9
Phoenix	Ariz.	30	27	2.3	11
Little Rock	Ark.	30	23	0.85	8.0
Berkeley	Calif.	30	35	0.93	14
Los Angeles	Calif.	30	61	4.4	17
Denver	Colo.	30	49	1.8	12
Hartford	Conn.	30	43	0.79	11
Washington	D. C.	30	37	4.1	12
Jacksonville	Fla.	28	32	4.6	12
Miami	Fla.	28	44	1.9	11
Atlanta	Ga.	29	25	1.2	8.1
Agana	Guam	21	5.3	0.11	1.9
Honolulu	Hawaii	30	20	<0.10	5.1
Boise	Idaho	30	50	3.0	18
Springfield	Ill.	29	47	0.84	9.1
Indianapolis	Ind.	30	23	2.1	7.5
Iowa City	Iowa	30	18	0.78	5.8
Topeka	Kans.	30	15	1.2	6.7
Frankfort	Ky.	26	20	1.6	8.0
New Orleans	La.	30	33	1.0	10
Baltimore	Md.	30	23	2.7	9.0
Lawrence	Mass.	29	15	0.29	5.5
Lansing	Mich.	30	40	2.9	11
Minneapolis	Minn.	30	35	1.3	7.1
Jackson	Miss.	29	32	2.3	8.4
Pascagoula	Miss.	17	27	0.62	12
Jefferson City	Mo.	30	30	0.85	6.8
Helena	Mont.	30	65	3.4	12
Lincoln	Nebr.	22	44	1.1	12
Trenton	New Jersey	30	18	2.2	7.0
Santa Fe	N. Mex.	30	30	2.3	12
Albany	N. Y.	30	47	1.3	8.4
New York	N. Y.	7	24	3.8	13
Gastonia	N. C.	30	35	0.77	9.5
Bismarck	N. Dak.	29	49	1.6	6.6
Columbus	Ohio	29	48	2.2	9.5
Oklahoma City	Okla	30	18	0.44	7.9
Ponca City	Okla.	28	10	0.20	4.1
Portland	Oreg.	30	36	2.0	11
Harrisburg	Pa.	30	25	2.8	7.0
San Juan	P. R.	25	9.6	0.16	3.1
Providence	R. I.	30	40	0.75	8.3
Columbia	S. C.	27	28	0.82	8.3
Pierre	S. Dak.	29	57	1.5	10
Nashville	Tenn.	28	30	1.1	9.8
Austin	Tex.	30	29	0.20	9.4
El Paso	Tex.	30	30	1.9	10
Salt Lake City	Utah	30	30	2.2	10
Richmond	Va.	30	33	1.7	8.3
Seattle	Wash.	30	19	0.91	6.1
Madison	Wis.	29	20	0.76	7.6
Cheyenne	Wyo.	30	28	1.3	10
Sundance	Wyo.	4	20	7.8	11
Network average					8.5

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, SEPTEMBER 1961

Station location		Rainfall (millimeters)	Deposition ($\mu\mu c/m^2$)	Station location		Rainfall (millimeters)	Deposition ($\mu\mu c/m^2$)
City	State			City	State		
Anchorage	Alaska	118.1	192,280	Helena	Montana	29.3	51,900
Fairbanks	Alaska	47.9	55,570	Las Vegas	Nevada	—	—
Juneau	Alaska	214.2	92,310	Trenton	New Jersey	—	—
Phoenix	Arizona	[a] —	—	Santa Fe	New Mexico	26.5	4,180
Little Rock	Arkansas	109.5	33,440	Albany	New York	39.0	10,240
Berkeley	California	9.6	1,680	New York	New York	—	—
Los Angeles	California	1.5	1,190	Gastonia	North Carolina	<0.1	260
Denver	Colorado	58.3	93,470	Bismarck	North Dakota	—	—
Hartford	Connecticut	40.7	8,070	Columbus	Ohio	—	—
Washington	District of Columbia	15.6	6,230	Oklahoma City	Oklahoma	51.8	21,730
Jacksonville	Florida	13.4	6,330	Ponca City	Oklahoma	123.5	145,420
Miami	Florida	—	—	Portland	Oregon	14.8	13,750
Atlanta	Georgia	16.1	3,200	Harrisburg	Pennsylvania	12.4	4,560
Honolulu	Hawaii	25.5	5,650	San Juan	Puerto Rico	—	—
Boise	Idaho	29.9	13,080	Providence	Rhode Island	75.2	15,100
Springfield	Illinois	127.5	42,770	Columbia	South Carolina	80.0	29,000
Indianapolis	Indiana	85.1	14,850	Pierre	South Dakota	40.1	28,250
Iowa City	Iowa	187.9	36,930	Nashville	Tennessee	—	—
Frankfort	Kentucky	—	—	Austin	Texas	103.2	18,150
Topeka	Kansas	118.0	126,540	El Paso	Texas	23.6	5,300
New Orleans	Louisiana	119.3	29,330	Salt Lake City	Utah	28.0	15,700
Baltimore	Maryland	—	—	Richmond	Virginia	26.0	38,280
Lawrence	Massachusetts	40.4	6,500	Seattle	Washington	16.5	14,230
Lansing	Michigan	57.0	8,680	Spokane	Washington	—	—
Minneapolis	Minnesota	40.0	14,500	Madison	Wisconsin	151.4	50,450
Pascagoula	Mississippi	33.0	41,250	Cheyenne	Wyoming	55.4	71,930
Jefferson City	Missouri	135.6	23,710				

[a] Dash denotes no sample received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Robert A. Taft Sanitary Engineering Center, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air at Cincinnati. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon-222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period October 9-November 3, 1961, appears in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, *22*, No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, OCTOBER 9–NOVEMBER 3, 1961

End of sampling period		Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222}[a] 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
		Sample change time	Sample period (hours)	Volume (m^3)				
October	9	0800	71.9	86.7	1090	200	12.1	7.23
	10	0802	24.0	28.7	1530	250	12.4	5.49
	11	0803	24.0	28.8	710	240	4.9	6.41
	12	0802	24.0	29.0	1170	220	8.7	5.53
	13	0801	23.9	28.7	1340	250	4.9	5.55
	16	0805	72.0	87.5	850	210	6.9	3.05
	17	0805	23.9	28.8	1450	200	5.8	3.51
	18	0800	23.8	28.0	1110	130	9.0	3.93
	19	0803	24.0	27.7	820	120	8.7	5.04
	20	0805	24.0	27.7	160	230	1.9	1.09
	23	0810	72.0	80.7	1060	400	9.2	3.41
	24	0801	23.8	27.1	1770	550	3.1	9.34
	25	0810	24.1	27.7	650	250	8.4	5.23
	26	0818	24.1	27.8	180	130	2.1	5.25
	27	0805	23.7	28.3	820	190	8.9	2.75
	30	0810	72.0	85.4	270	170	5.6	11.54
	31	0800	23.8	28.9	170	120	1.7	2.86
November	1	0814	24.2	29.7	820	280	3.7	2.17
	2	0807	23.8	29.3	390	100	3.6	3.42
	3	0813	24.1	29.7	100	30	0.1	1.88
Average					819	221	6.7	5.1
Range of counting errors (2σ)								
Maximum					76	40	1.2	0.2
Minimum					20	10	0.1	0.1

[a] Sample period and volume does not apply to this column.

Radioactivity Measurements In Surface Air

U.S. Naval Research Laboratory

Radioactivity measurements of air-filter samples collected at various sites near the 80th Meridian (West) are made by the U.S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during September 1961 is presented in table 1, and the radioactivity profile for the same month and the third quarter of 1961 are shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. Due to the increased levels of radioactivity, another cycle has been added to the figure. The abscissa is expressed in micromicrocuries per cubic meter of surface air. The concentrations in table 1 are expressed in disintegrations per minute per cubic meter of air at the collecting site (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

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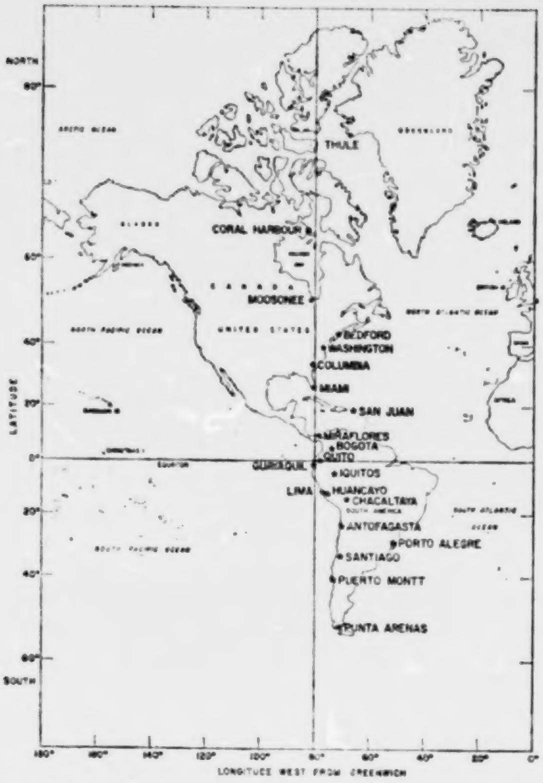
NORTH
80°
60°
40°
20°
0°
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60°
SOUTH
LATITUDE
ARCTIC OCEAN
GREENLAND
THULE
CORAL HARBOUR
CANADA
MOOSONEE
NORTH PACIFIC OCEAN
UNITED STATES
NORTH ATLANTIC OCEAN
BEDFORD
WASHINGTON
COLUMBIA
MIAMI
SAN JUAN
MIRAFLORES
BOGOTA
QUITO
GUAYAQUIL
IQUITOS
LIMA
HUANCAYO
CHACALTAYA
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
ANTOFAGASTA
PORTO ALEGRE
SOUTH PACIFIC OCEAN
SANTIAGO
PUERTO MONTT
PUNTA ARENAS
180°
160°
140°
120°
100°
80°
60°
40°
20°
0°
LONGITUDE WEST FROM GREENWICH

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

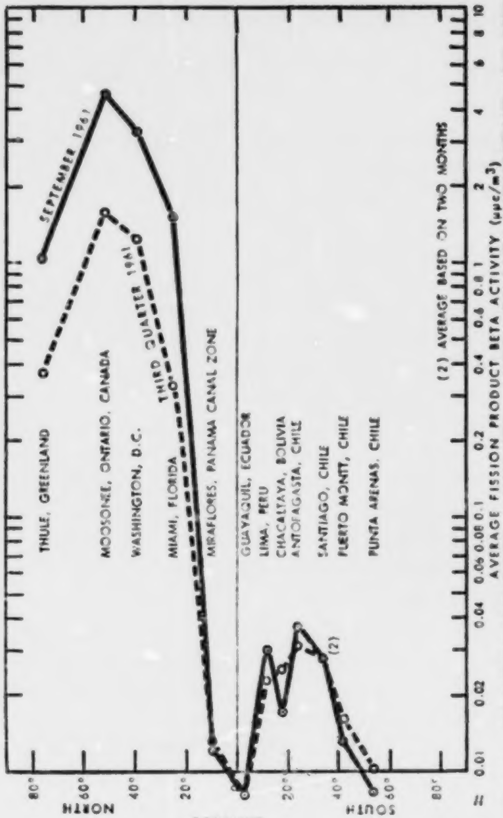

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (W), SEPTEMBER 1961

TABLE 1.—DAILY RECORD OF FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, SEPTEMBER 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil Ecuador	Miraflores, Panama Canal Zone	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	<0.01	0.03	0.03	0.12	0.04	0.07	0.02	0.03	0.06	0.07	0.10	0.06	0.03
2	<0.01	0.02	0.03	0.12	0.04	0.07	0.02	0.03	0.06	0.07	0.10	0.06	0.03
3	<0.01	0.02	0.03	0.12	0.04	0.07	0.02	0.03	0.06	0.07	0.10	0.06	0.03
4	<0.01	0.02	0.03	0.12	0.04	0.07	0.02	0.03	0.06	0.07	0.10	0.06	0.03
5	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.05	0.06
6	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.05	0.06
7	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.05	0.06
8	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.05	0.06
9	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.15	0.06
10	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.12	0.06
11	0.02	0.03	0.09	0.05	0.02	0.06	<0.01	0.01	0.20	0.07	0.09	0.19	0.06
12	0.02	0.03	0.05	0.10	0.04	0.04	<0.01	0.02	1.49	0.63	8.97	0.16	1.73
13	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	0.11	1.73
14	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	0.44	1.73
15	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	0.28	1.73
16	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	0.91	1.73
17	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	17.80	1.73
18	0.02	0.03	0.05	0.10	0.04	0.04	0.02	0.02	1.49	0.63	8.97	17.80	1.73
19	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	21.02	1.47
20	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	21.02	1.47
21	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	71.67	1.47
22	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	47.10	1.47
23	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	0.76	1.47
24	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	24.65	1.47
25	0.02	0.03	0.05	0.09	0.05	0.11	0.02	0.03	0.70	9.52	16.40	31.99	1.47
26	0.02	----------	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.41	8.95	9.31
27	0.02	----------	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.11	13.48	9.31
28	0.02	----------	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.41	----------	9.31
29	0.02	----------	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.41	----------	9.31
30	0.02	----------	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.41	----------	9.31
Mean (dpm/m³)	0.018	0.029	0.062	0.082	0.038	0.067	0.017	0.026	0.627	3.371	7.846	10.334	2.316
Mean (μμc/m³)	0.008	0.013	0.028	0.037	0.017	0.030	0.008	0.012	0.282	1.518	3.534	4.655	1.043

Canadian Radioactive Fallout Study Program

Department of National Health and Welfare, Ottawa, Canada

As part of its radioactive fallout study program, the Radiation Protection Division, Department of National Health and Welfare, Dominion of Canada, conducts air and precipitation sampling programs.

The nationwide air sampling program is conducted for two main purposes: (1) to provide a convenient method for the early detection of changes in the fission product concentration in the air and therefore of likely changes in the deposition products on the ground, and (2) to obtain data to show the day-to-day and station-to-station variations. This may be useful to meteorologists for obtaining a better understanding of the mechanisms involved in radioactive fallout distribution in the atmosphere.

A more detailed discussion of the sampling procedures, methods of analysis, and interpretation of results of the Department's radioactive fallout program is contained in the "Annual Report for 1959," Report Number CNHW (RP-3).

With the permission of the Department of National Health and Welfare, Dominion of Canada, *Radiological Health Data* published data on fission product gross beta activity in air and precipitation in Volume II, Numbers 1, 4, 8, and 12 covering the periods July 1959-June 1960, the third and fourth quarters 1960, and the first quarter 1961 respectively. In addition, daily measurements of gross beta radioactivity in air were presented for the period September 4 through October 15, 1961. Second quarter 1961 data are reported in tables 1, 2, and 3. Daily measurements of gross beta radioactivity for the latter part of October are presented in table 4. These data show continued higher levels, as noted earlier in October, which reflect increases due to the resumption of atmospheric nuclear weapons testing; however, the more recent daily data do not appear to be increasing. Unless a significant increase is observed, daily measurements will not be reported in future issues.

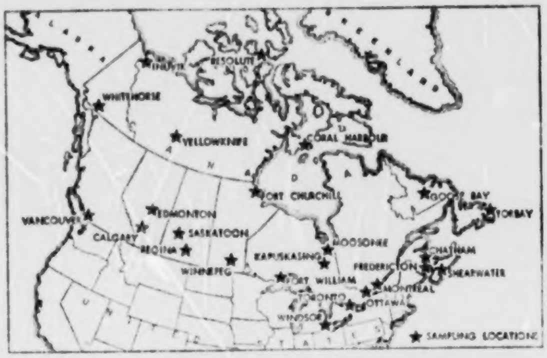

FIGURE 1.—CANADIAN AIR AND PRECIPITATION SAMPLING STATIONS

TABLE 1.—FISSION PRODUCT GROSS BETA RADIOACTIVITY IN AIR, SECOND QUARTER 1961

[Average concentration in $\mu\mu c/m^3$]

Station location	April	May	June
Calgary	0.17	0.23	0.26
Chatham	0.12	0.19	0.23
Coral Harbour	0.15	0.16	0.10
Edmonton	0.15	0.23	0.24
Fort Churchill	0.09	0.14	0.10
Fort William	0.14	0.22	0.24
Fredericton	0.10	0.15	0.19
Goose Bay	0.13	0.15	0.15
Inuvik	0.18	0.15	0.10
Kapuskasing	0.15	0.24	0.23
Montreal	0.10	0.19	0.25
Moosonee	0.14	0.20	0.16
Ottawa	0.12	0.17	0.20
Regina	0.17	0.27	0.29
Resolute	0.09	[a] NS	0.06
Saskatoon	0.17	0.24	0.25
Shearwater	0.09	0.17	0.16
Torbay	0.13	0.15	0.20
Toronto	0.14	0.21	0.24
Vancouver	0.12	0.17	0.16
Whitehorse	0.13	0.22	0.11
Windsor	0.17	0.27	0.26
Winnipeg	0.16	0.27	0.29
Yellowknife	0.18	0.21	0.23

[a] NS—No sample.

Overall monthly average levels of gross beta radioactivity in air in table 2 for the second quarter of 1961 are generally higher than those

TABLE 2.—MONTHLY AVERAGE FISSION PRODUCT GROSS BETA CONCENTRATIONS IN AIR, SECOND QUARTER 1961

[Radioactivity in $\mu\mu c/m^3$]

Month	Number of stations operating 50% of the time	Minimum average all stations	Maximum average all stations	Overall average
April	23	0.09	0.18	0.14
May	23	0.14	0.27	0.20
June	21	0.06	0.29	0.20

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of the first quarter, but appear to be constant during May and June. This is the usual pattern observed at this time of year.

The overall monthly average levels of precipitation in table 3 appear to be slightly higher than for the previous quarter. This is again consistent with the rises usually observed at this time of the year.

TABLE 3.—FISSION PRODUCT GROSS BETA RADIOACTIVITY IN PRECIPITATION, SECOND QUARTER 1961

Station location	April		May		June	
	Millimeters	μμc/liter	Millimeters	μμc/liter	Millimeters	μμc/liter
Calgary	37.8	42.5	42.7	66.9	9.9	15.2
Chatham	136.9	25.8	134.1	28.9	73.9	30.4
Coral Harbour	13.5	35.0	15.5	73.0	13.2	171.7
Edmonton	22.9	44.1	24.6	109.3	46.7	74.5
Fredericton	94.7	28.9	164.8	28.9	82.8	25.9
Fort Churchill	82.8	25.8	21.8	56.2	36.3	56.3
Fort William	39.6	30.4	59.2	51.7	35.1	80.5
Goose Bay	23.1	34.9	131.6	24.3	78.0	45.6
Inuvik	49.5	6.1	64.3	19.8	24.4	24.3
Kapuskasing	25.1	47.2	109.5	39.5	78.7	28.9
Montreal	105.9	9.1	62.5	21.3	146.6	10.6
Moosonee	16.3	50.2	[a] NS	—	69.1	88.2
Ottawa	100.6	24.3	86.6	30.4	92.7	38.0
Regina	13.7	60.9	57.2	68.4	13.7	142.9
Resolute	[a] NS	—	NS	—	NS	—
Saskatoon	27.7	42.6	[illegible]1.0	69.9	43.9	126.2
Shearwater	127.8	22.8	141.0	13.7	70.1	27.4
Torbay	120.4	27.4	91.7	18.2	36.8	15.2
Toronto	105.7	22.8	71.1	33.4	128.5	31.9
Vancouver	48.0	53.2	98.0	39.5	25.9	79.0
Whitehorse	16.3	66.9	4.8	320.7	88.1	30.4
Windsor	153.4	30.4	66.8	104.9	73.2	41.1
Winnipeg	43.2	60.9	9.9	124.6	3.3	256.8
Yellowknife	10.7	13.6	1.3	547.2	53.3	21.2
Average	—	35.8	—	85.5	—	63.6

[a] NS—No sample.

TABLE 4.—DAILY RECORD OF FISSION PRODUCT GROSS BETA RADIOACTIVITY IN AIR, OCTOBER 16 TO OCTOBER 31, 1961

[Concentrations in μμc/m³]

Station location	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Calgary	43.6	36.9	25.6	5.8	4.8	4.4	16.6	11.2	12.8	27.0	81.0	42.3	42.3	67.5	4.5	9.9
Chatham, N. B	8.8	7.1	10.8	22.3	5.0	5.0	15.1	13.1	18.0	18.0	1.8	4.4	3.7	11.2	22.0	15.3
Edmonton	72.0	72.9	14.2	21.6	1.8	2.5	3.6	26.1	12.8	18.0	27.9	24.3	17.1	45.0	12.4	6.8
Fort Churchill	7.2	4.3	2.1	6.6	10.1	26.1	7.5	3.2	6.1	10.4	8.3	10.0	12.6	6.5	6.8	24.8
Fort William	21.6	10.4	7.0	5.7	7.5	18.0	18.0	18.4	27.4	30.2	9.0	3.1	11.2	26.1	15.1	60.8
Fredericton	8.1	10.4	24.3	12.7	8.2	12.2	10.8	14.0	10.4	2.2	5.2	5.6	16.2	23.4	23.0	27.9
Goose Bay	3.6	8.8	6.2	5.9	11.2	10.8	4.3	23.2	23.4	20.2	13.3	7.0	7.7	3.3	0.6	0.4
Inuvik	5.0	3.5	1.9	1.9	10.1	[a]—	—	5.7	7.8	13.2	7.3	16.2	1.1	2.5	6.0	2.5
Kapuskasing	2.4	14.0	14.0	4.4	16.6	16.6	10.8	26.1	23.4	25.6	15.8	14.4	11.7	8.3	5.3	—
Montreal	23.4	30.6	10.0	23.3	11.2	8.1	16.6	20.7	14.0	13.5	16.6	7.1	19.4	37.4	43.9	24.3
Moosonee	15.7	15.7	6.7	—	11.2	10.2	22.6	21.6	27.0	23.0	17.1	4.3	3.6	7.2	19.2	—
Ottawa	23.8	18.0	32.4	21.4	14.4	18.0	33.8	21.6	20.2	17.1	13.0	6.9	14.4	42.8	36.0	32.0
Regina	4.3	20.9	9.0	16.8	19.4	8.8	8.6	21.6	21.2	11.0	7.0	13.5	25.6	11.2	20.5	36.4
Saskatoon	34.2	12.1	12.1	8.1	3.2	1.1	10.4	26.1	13.5	6.8	11.7	13.5	9.0	85.5	27.0	21.6
Shearwater	16.0	11.3	24.8	15.8	4.5	13.7	14.2	17.6	4.4	0.1	7.4	17.2	18.9	29.3	18.0	32.1
Torbay	8.6	24.5	30.2	—	18.2	8.3	18.0	18.9	18.9	20.7	5.3	0.7	17.1	6.8	14.4	11.7
Toronto	16.0	14.0	19.1	29.7	14.8	17.3	25.4	31.1	36.4	24.3	18.4	8.1	9.4	40.5	47.2	22.0
Vancouver	13.3	10.4	—	16.6	5.9	4.4	6.8	5.0	7.2	36.0	9.9	13.5	3.1	—	7.1	—
Whitehorse	9.1	6.6	12.2	17.1	11.0	21.4	9.0	4.5	15.3	4.3	7.6	4.4	6.8	16.6	17.6	6.3
Windsor	19.4	35.6	23.0	—	6.5	16.6	27.9	49.5	24.3	12.6	15.3	7.4	27.0	58.5	32.0	13.7
Winnipeg	3.4	14.4	3.8	7.9	14.2	18.9	14.9	35.1	15.8	12.2	9.4	15.8	19.4	13.0	83.2	10.3
Yellowknife	4.5	3.2	0.8	4.2	7.9	15.0	6.9	3.7	7.6	47.2	7.4	7.2	4.1	5.4	8.3	6.5
Average	16.6	17.5	13.8	13.1	9.9	12.2	14.4	19.0	16.7	17.9	14.4	11.2	13.7	26.1	21.0	19.2

[a] Dash denotes no sample.

SECTION II. — FOOD OTHER THAN MILK

Radiation Intelligence Network

Division of Radiological Health, Public Health Service

The March 1961 *Radiological Health Data* discussed the Radiation Intelligence Network and outlined two total diet sampling programs that were in progress. The following is a report on the Institutional Diet Sampling Program which studies the dietary intake of the critical younger age group, specifically, persons under 18.

INSTITUTIONAL DIET SAMPLING PROGRAM

Criteria for Pilot Study

In outlining the initial surveillance plan for the estimate of radiation exposure levels resulting from the ingestion of radioactivity in the total diet, the following basic criteria were established for the locations where sampling operations were to be carried out.

a. Composite diet at point of consumption. Preliminary studies of data available concerning food consumption habits in the United States indicated that the pilot study should not be based on market survey information as it appeared that these data were not precise enough to furnish the necessary information on the radioactivity intake. Estimates based on available information of the variation in eating habits, as well as consideration of the minimum quantities of food required for radioassay, resulted in the selection of a minimum composite diet sample of 21 consecutive meals including snacks or other dietary intake to be assayed each month.

b. Controlled population in specific age group. Initial sampling was concentrated on a young age group, specifically persons under 18, due to the relative importance of radiation exposure for this population group. The conclusion was soon reached that the "boarding school," or similar institution for children, offered the best opportunity for sampling in the initial phases of the study. Since stability was considered an important population characteristic, the relative permanence of membership within such institutions was thought to present the best opportunity for investigation of potential relationships or associations between food intake, radiation exposure, and the demographic characteristics of a group for study during a period of months to years.

c. Geographic spread. Because of the expected regional variation in food consumption patterns, the broadest possible geographic representation was included in the selection of sampling points. The assumption was made that the pattern of food consumption at each selected institution would generally reflect the pattern extent for the geographical region. No attempt was made to set standards of economic

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condition for the institution selected, in fact, in selecting the sampling points some effort was made to pick institutions with some variation in this characteristic.

d. On-site food service. An additional requirement imposed for the selection of institutions for diet sample collection was that an on-site food service be in operation, providing three complete meals each day to the population group under study. Those institutions using government surplus food were generally avoided as the prolonged storage of such food might produce results atypical of the area under study.

Field Sampling Operations

The current institutional diet sampling program in operation consists of 13 boarding schools or institutions scattered throughout the United States. They represent young people between the ages of 5 and 18 and range from exclusive and expensive boarding schools to orphanages with severe economic limitations. Initially, seven sampling points were set up as pilot stations to perfect sample collection, transportation, and routine laboratory assay techniques. Each location is supported by a regular Pasteurized Milk Monitoring Program sampling station and by regular municipal water supply analytical data. This sampling program will be increased to at least 20 institutions during 1962. The following 13 locations are being sampled as of December 1961:

Atlanta, Georgia
Austin, Texas
Boston, Massachusetts
Chicago, Illinois
Denver, Colorado
Helena, Montana
Honolulu, Hawaii
Los Angeles, California
Memphis, Tennessee
New York, New York
Palmer, Alaska
Salt Lake City, Utah
Seattle, Washington
St. Louis, Missouri
Tampa, Florida

In general, the sampling procedure is the same in each case. Each sample, as it reaches the laboratory, represents a full seven-day week diet of 21 meals plus soft drinks, candy bars, or other in-between snacks obtained by duplicating the meals of a different individual each day. Each institution supplies one total 7-day diet sample each month.

Upon completion of the sampling procedure, the frozen sample is placed in the shipping carton together with an adequate supply of dry ice and shipment by air-express to either the Southwestern or Southeastern Radiological Health Laboratory at Las Vegas, Nevada, or Montgomery, Alabama, respectively. Each sample usually consists of 6 to 16 liters, weighing between 8 to 20 kilograms.

Analytical Program for Food Sample

The basic analytical program for the Institutional Diet Sampling Program was designed around three basic procedures: (1) gamma scan, (2) strontium-90 analysis, and (3) total radium analysis. In the absence of interference, other than naturally-occurring radioactive potassium (K^{40}), minimum detecable levels on a per kilogram basis are 10, 5, 450 and 15 μμc for iodine-121, cesium-137, potassium-40 and zinc-65 respectively. Gamma scan results for composite food samples obtained before and after the nuclear weapons test moratorium have shown marked differences. The principal activity observed prior to the resumption of testing is that of potassium-40, though earlier samples contained small amounts of cesium-137, while iodine-131 and other fission product radionuclides appeared after September 1961.

Total weight, ash and moisture determination and stable calcium and potassium are obtained by conventional gravimetric or spectrophotometric methods. Values for potassium-40 intake range from 440 to 3,800 μμc per day with an average of 2,300 μμc per day. Phosphate determinations are by colorimetric technique. Calcium or phosphorous compounds may have an effect on the uptake of important bone seeking radionuclides such as strontium-89 and 90. Hence, these determinations were included in the analytical program. Total radium is determined by ashing, separation, and coprecipitation of radium and barium sulphate or chromate. After transfer to planchets, alpha activity is determined by an internal proportional counter with appropriate delay for check of ingrowth of radium daughters. As soon as emanation equipment is installed and calibrated, a specific determination for radium-226 will be made. The total radium technique is a practical screening indicator, but other natural radionuclides may contribute to the reported total radium values and hence, the bone dose calculated by assuming radium-226 is correspondingly but conservatively high.

Summary of Results

1. The dietary intake of strontium-90 by young people for all sampling points was estimated by this program to range from 1.3 to 14.6 μμc/day from food, beverages, and snacks served in boarding schools at several locations in this country. This value lies within the lowest radiation protection guidance limit of the Federal Radiation Council of 0 to 20 μμc/day for strontium-90.

2. The dietary intake of total radium by the children studied was estimated to be 1.7 to 12.7 μμc/day with an average intake of 5.9 μμc/day. Assuming the radium-226 component of the total radium activity is at least 30 percent, the intake of radium-226 via the diet lies near the upper limit of the Range I level of the radiation protection guidance of the Federal Radiation Council (of 0 to 2 μμc per day for radium-226).

3. The rapid scanning of composite diet samples by means of crystal detectors and gamma spectrometry is a useful method of establishing limits of possible contamination of food by gamma emitting radionuclides. A 3½ liter volume, or the solid equivalent, of the sample is counted. It is important to count fairly large amounts of low-level samples in order to measure as much total activity as possible. Using this technique, the minimum levels of detection, on a per kilogram basis, are: 10, 5, 450, and 15 μμc for iodine-131, cesium-137, potassium-40, and zinc-65, respectively. The weights of 3½ liters of composite food samples may vary from 6 to 8 percent, depending primarily upon the amount of moisture contained in a given sample. The reported absence then, of identifiable peaks in the gamma scan, reflects the absence of the above radionuclides at the level indicated.

4. Though attempts were made to document the diet items by menu as served at the sampling point, the variation in radioactivity content due to strontium-90 and radium could not be attributed to the presence of any specific diet item. Comparison of the total diet intake levels of strontium-90 with those previously reported for milk confirms previous estimates that milk may account for approximately one-half of the dietary intake of this radionuclide.

5. Preliminary results of tests made at two sampling stations for iodine-131 since resumption of nuclear weapons testing, show that the principal contributor of this radionuclide to the dietary intake of children is fresh milk. Iodine-131, as indicated by the milk sampling program has been absent during the last two years of the weapons test moratorium. This has been the case for strontium-89 and barium-lanthanum-140, with only the long half-life cesium-137 and strontinum-90 evidence in milk.

Discussion

The Institutional Diet Sampling Program is directed to determining both technical and administrative feasibility of estimating ranges of radiation exposure resulting from the ingestion of radioactivity in the diet. As a preliminary pilot study, this has been demonstrated successfully, subject to the limitations imposed by sampling techniques. It must be assumed that the samples obtained actually are representative of the average dietary intake for the institution. This latter factor is now the subject of careful investigation and study. It is not believed at this time that the type of surveillance which will be developed from this study for routine purposes will be adequate to initiate control measures or countermeasures that might become necessary as a result of increased fallout levels. It is believed that such studies must be carried out in more detail at the State and local levels. Studies on these problems are concurrently being conducted by the Public Health Service in cooperation with the State and local health authorities under the guidance of the National Advisory Committee on Radiation to the Surgeon General.

Tables 1 and 2 present the results for January through August 1961.

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TABLE 1.—INSTITUTIONAL DIET SAMPLING—SEVEN-DAY COMPOSITE SAMPLES, 1961

Location	Data	January	February	March	April	May	June	July	August	Daily average
Los Angeles, California	Wt. (Kg)[1]		10.8	18.1	12.0	12.0	11.9	5.4		1.7
	Moisture (Kg)				9.2	9.2	8.9	4.0		1.1
	Ash (gm)		94	114	100	100	32	49		12.1
	Ca (gm)		4.54	5.61	6.96	6.96	16.5			1.2
	Ra (μμc)		18	42	36	36	27	41		4.8
	Sr 90 (μμc)		38	23	28	28	<26	29		4.0
Denver, Colorado	Wt. (Kg)	7.2	12.8	14.6	11.8	20.8		9.7	18.7	2.0
	Moisture (Kg)					15.6		7.3	14.9	1.8
	Ash (gm)	62	123	168	123	198		61	166	18.4
	Ca (gm)	3.82	6.14	10.51	7.55	12.9		10.28	12.5	1.3
	Ra (μμc)	16	12	68	47	48		54	84	7.1
	Sr 90 (μμc)	24	74	17	21	56		15	34	5.0
Atlanta, Georgia	Wt. (Kg)			12.1	13.0	11.1	9.4	11.8	11.7	1.6
	Moisture (Kg)						6.9	9.3	9.1	1.2
	Ash (gm)			129	134	119	123	98	65	15.9
	Ca (gm)			7.0	8.3	6.3	9.2	5.80	3.9	0.96
	Ra (μμc)			21	[2] <20	28	<55	50	<26	4.8
	Sr 90 (μμc)			66	61	49	64	30	33	7.7
St. Louis, Missouri	Wt. (Kg)	12.4	16.1	13.2	16.0	11.9		22.5	18.5	2.2
	Moisture (Kg)					9.5		17.6	14.1	2.0
	Ash (gm)	104	159	149	176	91		204	212	22.3
	Ca (gm)	5.1	6.9	8.4	9.8	5.7		11.2	12.2	1.4
	Ra (μμc)	42	51	54	70	33		72	89	8.4
	Sr 90 (μμc)	93	92	29	53	42		<102	63	9.7
New York City, New York	Wt. (Kg)	10.6	8.4	7.6	5.6	10.1	11.4	4.3	9.1	1.2
	Moisture (Kg)					7.2	8.6	2.6	6.4	0.9
	Ash (gm)	105	72	79	75	108	100	47	105	12.3
	Ca (gm)	2.4	4.2	3.3	1.8	5.1	6.9	1.9	8.4	0.61
	Ra (μμc)	<20	<20	<20	<16	20	<25	<20	<42	3.3
	Sr 90 (μμc)	48	19	35	20	35	39	9	65	4.8
Austin, Texas	Wt. (Kg)		15.9	17.1	17.3	14.7	17.3	16.8	18.2	2.4
	Moisture (Kg)					10.8	12.4	12.5	13.3	1.8
	Ash (gm)		152	185	165	153	186	164	177	24.1
	Ca (gm)		8.8	10.1	10.6	9.0	11.2	9.8	11.0	1.43
	Ra (μμc)		<32	<25	<25	<50	<70	<70	<70	7.0
	Sr 90 (μμc)		61	73	73	65	35	98	87	10.0
Seattle, Washington	Wt. (Kg)		15.5	18.4	16.9	15.1	17.0	13.8	16.1	2.3
	Moisture (Kg)					11.6	13.2	10.9	13.2	1.7
	Ash (gm)		147	138	169	153	148	134	150	21.2
	Ca (gm)		6.8	8.6	7.9	8.0	14.1	8.9	9.2	1.3
	Ra (μμc)		26	15	46	23	83	50	42	6.0
	Sr 90 (μμc)		88	40	69	23	58	13	56	7.1

[1] Total weight of original seven-day sample.
[2] Radium and strontium-90 values shown at the detection limit are included in the averages as detection limit values.

TABLE 2.—DAILY INTAKE OF RADIUM AND STRONTIUM-90 VIA THE TOTAL DIET OF CHILDREN UNDER 18[1]

[Concentrations in μμc/day]

Location	No. of weekly samples	Strontium-90			Radium		
		High	Low	Average	High	Low	Average
California	6	5.4	3.3	4.0	6	2.6	4.8
Colorado	7	10.6	2.2	5.0	12.6	1.7	7.1
Georgia	6	9.4	4.7	7.7	7.9	2.9	4.8
Missouri	7	14.6	4.1	9.7	12.7	4.7	8.4
New York	8	9.3	1.3	4.8	6.0	2.3	3.3
Texas	7	14.0	5.0	10.0	10.0	2.1	7.0
Washington	7	12.6	2.0	7.1	11.9	2.1	6.0
All stations	48	14.6	1.3	6.9	12.7	1.7	5.8

[1] Computed from measured Sr-90 and radium content of weekly composite samples, exclusive of drinking water but including all beverages and snacks. Samples collected at boarding schools for children at locations shown between January 1961 and August 1961.

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SECTION III. — MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *Radiological Health Data* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

Surveillance of pasteurized milk is currently conducted at 60 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies, who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication of data follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within most states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

Normally, assays for strontium-89, strontium-90, iodine-131, cesium-137, barium-140, and stable calcium are performed on the one sample obtained at each sampling location during the month. The regular September pasteurized milk samples in most cases were obtained during the first 15 days of the month, before any effect of Russian atmospheric nuclear weapons testing was observed. Prior to this time, the values for strontium-89, barium-140, and iodine-131 were below the level of detection by current instrumentation. The lower level of detection for strontium-89 is 5 μμc/liter, and for barium-140 and iodine-131, 10 μμc/liter.

During the second week in September, when increased levels of gross beta radioactivity in air were observed by the Radiation Surveillance Network, the frequency of milk sampling was accelerated at selected stations. Daily sampling of pasteurized milk, with analyses for iodine-131 content, was initiated on September 19 at six selected stations.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The cesium-137 and barium-140 data were determined on most of the milk samples obtained for iodine-131 analyses by the Southwestern Radiological Health Laboratory.

Because the normal monthly milk sample was taken during the first half of September when the levels were representative of those that have existed for the past year and more samples were obtained during the last half of September, special treatment of the data was necessary. To determine the average for the month of September, the value for the one sample taken in the first 15 days was weighted the same as the average value of all the samples taken during the last half of the month. When a radionuclide was not detectable, one-half of the nondetectable value was used for averaging. If no additional samples were obtained for a station when the level was nondetectable during the first 15 days of September, a dash appears in the table, indicating that no fully representative average for the month or quarter could be determined.

Table 1 presents a summary of all available analyses. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the

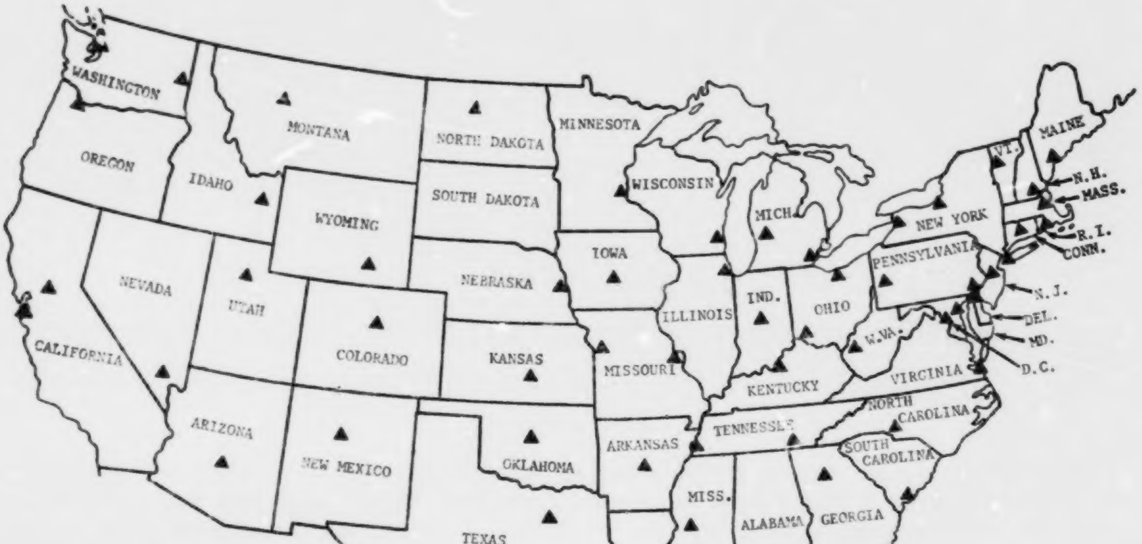
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICH.
IND.
OHIO
KENTUCKY
TENNESSEE
MISS.
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W.VA.
PENNSYLVANIA
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
D.C.
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS

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TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, SEPTEMBER 1961

[Radioactivity concentrations in μμc/liter]

Area		Calcium (gm/liter)			Strontium-89		Strontium-90			Iodine-131		Cesium-137			Barium-140	
City	State	Second quarter	Third quarter	September[a]	Third quarter	September[a]	Second quarter	Third quarter	September[a]	Third quarter	September[a]	Second quarter	Third quarter	September[a]	Third quarter	September[a]
Palmer	Alaska	1.03	1.12	1.10	[b] —	—	9	7	7	—	—	5	10	20	—	—
Phoenix	Ariz.	0.97	1.04	1.06	—	—	5	4	4	—	—	5	<5	5	—	—
Little Rock	Ark	1.21	1.21	1.22	—	—	19	16	16	—	—	25	10	10	—	—
Sacramento	Calif	1.05	1.10	1.25 (2)	<5	<5 (2)	5	5	6 (2)	<10	10 (3)	<5	10	15 (3)	<10	<10 (3)
San Francisco	Calif	1.04	1.06	1.06	—	—	5	4	4	—	—	10	10	15	—	—
Denver	Colo.	1.01	1.05	1.07 (2)	<5	5 (2)	6	5	5 (2)	20	60 (4)	5	10	15 (4)	<10	10 (4)
Hartford	Conn.	1.17	1.15	1.15	—	—	9	8	7	—	—	30	15	10	—	—
Wilmington	Del.	1.20	1.18	1.16	—	—	10	10	9	—	—	15	15	<5	—	—
Washington	D. C.	1.18	1.14	1.18 (2)	5	10 (2)	8	7	7 (2)	20	40 (5)	20	10	<5	<10	<10 (2)
Tampa	Fla.	1.23	1.24	1.26 (3)	<5	<5 (3)	6	5	5 (3)	20	40 (7)	110	85	100 (4)	<10	<10 (3)
Atlanta	Ga.	1.29	1.23	1.20 (4)	<5	5 (4)	10	10	9 (4)	30	80 (8)	20	15	15 (5)	<10	<10 (4)
Honolulu	Hawaii	0.96	1.06	1.14	—	—	4	6	7	—	—	10	10	5	—	—
Idaho Falls	Idaho	1.04	1.05	1.04	—	—	5	6	3	—	—	10	5	5	—	—
Chicago	Ill.	1.17	1.14	1.15 (2)	10	20 (2)	8	5	5 (2)	46	110 (2)	10	15	10 (2)	<10	<10 (2)
Indianapolis	Ind.	1.23	1.18	1.18	—	—	8	6	6	—	—	10	10	<5	—	—
Des Moines	Iowa	1.01	1.04	1.02	—	—	7	7	7	—	—	5	10	10	—	—
Witchita	Kans.	1.01	1.08	1.00	—	—	8	11	13	—	—	10	5	10	—	—
Louisville	Ky.	1.18	1.15	1.18	—	—	11	9	11	—	—	10	5	<5	—	—
New Orleans	La.	1.30	1.28	1.27 (3)	5	10 (3)	13	13	13 (3)	30	90 (10)	20	25	25 (4)	<10	10 (3)
Portland	Maine	1.26	1.19	1.20 (2)	10	20 (2)	10	9	7 (2)	10	20 (2)	40	30	20 (2)	<10	<10 (2)
Baltimore	Md.	1.23	1.16	1.20	—	—	8	10	8	—	—	15	15	10	—	—
Boston	Mass.	1.21	1.17	1.16	—	—	11	10	9	—	—	35	30	20	—	—
Detroit	Mich.	1.17	1.14	1.16	—	—	8	6	6	—	—	15	5	<5	—	—
Grand Rapids	Mich.	1.25	1.18	1.18	—	—	7	7	9	—	—	15	5	<5	—	—
Minneapolis	Minn.	1.07	1.07	1.06	—	—	7	9	5	—	—	10	15	10	—	—
Jackson	Miss.	1.35	1.26	1.30 (3)	5	10 (3)	14	12	13 (3)	50	150 (8)	15	15	20	<10	<10 (3)
Pascagoula	Miss.	NA	NA	NA	NA	NA	NA	NA	NA	70	200 (2)	NA	NA	NA	NA	NA
Kansas City	Mo.	1.08	1.04	1.05	—	—	12	9	7	—	—	15	5	5	—	—
St. Louis	Mo.	1.09	1.07	1.09 (3)	10	30 (3)	8	8	10 (3)	60	180 (11)	20	10	15 (11)	<10	10 (11)
Helena	Mont.	1.02	1.05	1.02	—	—	6	7	10	—	—	10	15	25	—	—
Omaha	Nebr	1.07	1.13	1.04	—	—	6	8	6	—	—	10	10	15	—	—
Manchester	N. H.	1.23	1.19	1.19	—	—	12	9	8	—	—	45	40	20	—	—
Trenton	N. J.	1.17	1.14	1.14	—	—	9	8	8	—	—	15	10	<5	—	—
Albuquerque	N. Mex.	1.06	1.09	1.06	—	—	5	3	3	—	—	5	5	10	—	—
Buffalo	N. Y.	1.22	1.13	1.10	—	—	8	7	7	—	—	15	10	10	—	—
New York	N. Y.	1.17	1.13	1.16 (2)	5	10 (2)	9	9	10 (2)	50	140 (3)	25	15	15	10	20 (2)
Syracuse	N. Y.	1.19	1.15	1.15	—	—	7	6	6	—	—	15	10	10	—	—
Charlotte	N. C.	1.25	1.22	1.19	—	—	12	12	11	—	—	15	10	10	—	—
Minot	N. Dak.	—	1.04	1.04	5 (1)	15 (1)	—	7 (1)	7 (1)	20 (2)	30 (2)	—	10 (1)	10 (1)	10 (1)	<10 (1)
Cincinnati	Ohio	1.24	1.20	1.17	—	—	9	9	10	—	—	10	<5	<5	—	—
Cleveland	Ohio	1.20	1.17	1.16	—	—	8	7	8	—	—	10	5	10	—	—
Oklahoma City	Okla.	1.22	1.19	1.20	—	—	8	6	6	—	—	5	5	10	—	—
Portland	Oreg.	1.05	1.10	1.14	—	—	12	11	8	—	—	30	20	25	—	—
Philadelphia	Pa.	1.18	1.18	1.18	—	—	9	8	6	—	—	15	15	10	—	—
Pittsburgh	Pa.	1.27	1.15	1.16	—	—	12	11	10	—	—	20	10	<5	—	—
San Juan	P. R.	1.23	1.17	1.18	—	—	4	4	5	—	—	5	10	15	—	—
Providence	R. I.	1.17	1.15	1.15	—	—	10	12	10	—	—	40	30	20	—	—
Charleston	S. C.	1.25	1.22	1.23 (3)	<5	5 (3)	12	11	12 (3)	30	90 (6)	25	30	35 (5)	<10	<10 (3)
Chattanooga	Tenn.	1.33	1.28	1.30	—	—	11	12	12	—	—	15	15	10	—	—
Memphis	Tenn.	1.30	1.23	1.20	—	—	13	12	14	—	—	10	5	5	—	—
Austin	Tex.	1.24	1.20	1.17	<5	<5 (3)	3	2	3 (3)	10	20 (4)	5	<5	<5 (2)	<10	<10 (3)
Dallas	Tex.	1.24	1.17	1.18	<5	5 (2)	9	6	5 (2)	10	20 (2)	10	10	10 (2)	<10	<10 (2)
Salt Lake City	Utah	1.01	1.16	1.19 (2)	5	10 (2)	5	4	5 (2)	50	140 (2)	10	10	15 (2)	<10	<10 (2)
Burlington	Vt.	1.22	1.14	1.08	—	—	8	8	6	—	—	15	15	15	—	—
Norfolk	Va.	1.28	1.22	1.24	—	—	9	9	10	—	—	20	10	<5	—	—
Seattle	Wash.	1.03	1.06	1.09 (2)	10	25 (2)	9	11	11 (2)	<10	10 (2)	25	15	15 (2)	<10	<10 (2)
Spokane	Wash.	1.02	1.04	1.04	—	—	8	9	6	—	—	15	20	20	—	—
Charleston	W. Va.	1.20	1.17	1.19	—	—	9	11	12	—	—	15	10	<5	—	—
Milwaukee	Wis.	1.19	1.17	1.19	—	—	6	5	5	—	—	20	10	<5	—	—
Laramie	Wyo.	1.00	1.04	1.04	—	—	5	7	7	—	—	10	15	20	—	—

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[a] Numbers in parentheses indicate total number of analyses reported during September. The regular monthly sample, taken during the first two weeks of September (before the effect of the Russian atmospheric nuclear weapons testing), is weighted for 15 days and the average of those analyses reported during the last two weeks is also weighted for 15 days to obtain the September average.

Absence of parentheses indicates that one sample was taken prior to the effect of the Russian testing in the atmosphere during September.

[b] Dash indicates that the concentration was reported to be less than the level of detection. The sample was collected prior to the effect of Russian testing.

[c] NA indicates no analyses reported.

average for the month. Some of the strontium-89 and strontium-90 data are based on weekly composites of daily samples taken near the end of September.

The sampling schedule in effect during most of October 1961 was presented in the January 1962 *Radiological Health Data*. With the conclusion of the Soviet Union's 1961 series of atmospheric tests, the iodine-131 levels are more predictable and it becomes necessary for the analytical program to shift to other radionuclides. This need is emphasized by the fact that the analytical procedures become more difficult as the levels of activity become lower and the longer lived nuclides increase in relative importance. Therefore, beginning in December 1961, the following sampling schedule became effective:

1. Six daily sampling stations (St. Louis, Seattle, New York, Chicago, Boston, and New

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, SEPTEMBER 1961

[Radioactivity concentrations in μμc/liter]

Area		Calcium (gm/liter)			Strontium-89		Strontium-90			Iodine-131		Cesium-137			Barium-140	
City	State	Second quarter	Third quarter	September[a]	Third quarter	September[a]	Second quarter	Third quarter	September[a]	Third quarter	September[a]	Second quarter	Third quarter	September[a]	Third quarter	September[a]
Palmer	Alaska	1.03	1.12	1.10	[b] —	—	9	7	7	—	—	5	10	20	—	—
Phoenix	Ariz.	0.97	1.04	1.06	—	—	5	4	4	—	—	5	<5	5	—	—
Little Rock	Ark	1.21	1.21	1.22	—	—	10	16	16	—	—	25	10	10	—	—
Sacramento	Calif	1.05	1.10	1.25 (2)	<5	<5 (2)	6	5	6 (2)	<10	10 (3)	<5	10	15 (3)	<10	<10 (3)
San Francisco	Calif	1.04	1.06	1.06	—	—	5	4	4	—	—	10	10	15	—	—
Denver	Colo.	1.01	1.05	1.07 (2)	<5	5 (2)	6	5	5 (2)	20	60 (4)	5	10	15 (4)	<10	10 (4)
Hartford	Conn.	1.17	1.15	1.15	—	—	9	8	7	—	—	30	15	10	—	—
Wilmington	Del.	1.20	1.18	1.16	—	—	10	10	9	—	—	15	15	<5	—	—
Washington	D. C.	1.18	1.14	1.18 (2)	5	10 (2)	8	7	7 (2)	20	40 (5)	20	10	<5	<10	<10 (2)
Tampa	Fla.	1.23	1.24	1.26 (3)	<5	<5 (3)	6	5	5 (3)	20	40 (7)	110	85	100 (4)	<10	<10 (3)
Atlanta	Ga.	1.29	1.23	1.20 (4)	<5	5 (4)	10	10	9 (4)	30	80 (8)	20	15	15 (5)	<10	<10 (4)
Honolulu	Hawaii	0.96	1.06	1.14	—	—	4	6	7	—	—	10	10	5	—	—
Idaho Falls	Idaho	1.04	1.05	1.04	—	—	5	6	3	—	—	10	5	5	—	—
Chicago	Ill.	1.17	1.14	1.15 (2)	10	20 (2)	8	5	5 (2)	40	110 (2)	10	15	10 (2)	<10	<10 (2)
Indianapolis	Ind.	1.23	1.18	1.18	—	—	8	6	6	—	—	10	10	<5	—	—
Des Moines	Iowa	1.01	1.04	1.02	—	—	7	7	7	—	—	5	10	10	—	—
Witchita	Kans.	1.01	1.08	1.00	—	—	8	11	13	—	—	10	5	10	—	—
Louisville	Ky.	1.18	1.15	1.18	—	—	11	9	11	—	—	10	5	<5	—	—
New Orleans	La.	1.30	1.28	1.27 (3)	5	10 (3)	13	13	13 (3)	30	90(10)	20	25	25 (4)	<10	10 (3)
Portland	Maine	1.26	1.19	1.20 (2)	10	20 (2)	10	9	7 (2)	10	20 (2)	40	30	20 (2)	<10	<10 (2)
Baltimore	Md.	1.23	1.16	1.20	—	—	8	10	8	—	—	15	15	10	—	—
Boston	Mass.	1.21	1.17	1.16	—	—	11	10	9	—	—	35	30	20	—	—
Detroit	Mich.	1.17	1.14	1.16	—	—	8	6	6	—	—	15	5	<5	—	—
Grand Rapids	Mich.	1.25	1.18	1.18	—	—	7	7	9	—	—	15	5	<5	—	—
Minneapolis	Minn.	1.07	1.07	1.06	—	—	7	9	5	—	—	10	15	10	—	—
Jackson	Miss.	1.35	1.26	1.30 (3)	5	10 (3)	14	12	13 (3)	50	150 (8)	15	15	20	<10	<10 (3)
Pascagoula	Miss.	[c] NA	NA	NA	NA	NA	NA	NA	NA	70	200 (2)	NA	NA	NA	NA	NA
Kansas City	Mo.	1.08	1.04	1.05	—	—	12	9	7	—	—	15	5	5	—	—
St. Louis	Mo.	1.09	1.07	1.09 (3)	10	30 (3)	8	8	10 (3)	60	180(11)	20	10	15(11)	<10	10(11)
Helena	Mont.	1.02	1.05	1.02	—	—	6	7	10	—	—	10	15	25	—	—
Omaha	Nebr	1.07	1.13	1.04	—	—	6	8	6	—	—	10	10	15	—	—
Manchester	N. H.	1.23	1.19	1.19	—	—	12	9	8	—	—	45	40	20	—	—
Trenton	N. J.	1.17	1.14	1.14	—	—	9	8	8	—	—	15	10	<5	—	—
Albuquerque	N. Mex.	1.06	1.09	1.06	—	—	5	3	3	—	—	5	5	10	—	—
Buffalo	N. Y.	1.22	1.13	1.10	—	—	8	7	7	—	—	15	10	10	—	—
New York	N. Y.	1.17	1.13	1.16 (2)	5	10 (2)	9	9	10 (2)	50	140 (3)	25	15	15	10	20 (2)
Syracuse	N. Y.	1.19	1.15	1.15	—	—	7	6	6	—	—	15	10	10	—	—
Charlotte	N. C.	1.26	1.22	1.19	—	—	12	12	11	—	—	15	10	10	—	—
Minot	N. Dak.	—	1.04	1.04	5 (1)	15 (1)	—	7 (1)	7 (1)	20 (2)	30 (2)	—	10 (1)	10 (1)	10 (1)	<10 (1)
Cincinnati	Ohio	1.24	1.20	1.17	—	—	9	9	10	—	—	10	<5	<5	—	—
Cleveland	Ohio	1.20	1.17	1.16	—	—	8	7	8	—	—	10	5	10	—	—
Oklahoma City	Okla.	1.22	1.19	1.20	—	—	8	6	6	—	—	5	5	10	—	—
Portland	Oreg.	1.05	1.10	1.14	—	—	12	11	8	—	—	30	20	25	—	—
Philadelphia	Pa.	1.18	1.18	1.18	—	—	9	8	6	—	—	15	15	10	—	—
Pittsburgh	Pa.	1.27	1.15	1.16	—	—	12	11	10	—	—	20	10	<5	—	—
San Juan	P. R.	1.23	1.17	1.18	—	—	4	4	5	—	—	5	10	15	—	—
Providence	R. I.	1.17	1.15	1.15	—	—	10	12	10	—	—	40	30	20	—	—
Charleston	S. C.	1.25	1.22	1.23 (3)	<5	5 (3)	12	11	12 (3)	30	90 (6)	25	30	35 (5)	<10	<10 (3)
Chattanooga	Tenn.	1.33	1.28	1.30	—	—	11	12	12	—	—	15	15	10	—	—
Memphis	Tenn.	1.30	1.23	1.20	—	—	13	12	14	—	—	10	5	5	—	—
Austin	Tex.	1.24	1.20	1.17	<5	<5 (3)	3	2	3 (3)	10	20 (4)	5	<5	<5 (2)	<10	<10 (3)
Dallas	Tex.	1.24	1.17	1.18	<5	5 (2)	9	6	5 (2)	10	20 (2)	10	10	10 (2)	<10	<10 (2)
Salt Lake City	Utah	1.01	1.16	1.19 (2)	5	10 (2)	5	4	5 (2)	50	140 (2)	10	10	15 (2)	<10	<10 (2)
Burlington	Vt.	1.22	1.14	1.08	—	—	8	8	6	—	—	15	15	15	—	—
Norfolk	Va.	1.26	1.22	1.24	—	—	9	9	10	—	—	20	10	<5	—	—
Seattle	Wash.	1.03	1.06	1.09 (2)	10	25 (2)	9	11	11 (2)	<10	10 (2)	25	15	15 (2)	<10	<10 (2)
Spokane	Wash.	1.02	1.04	1.04	—	—	8	9	6	—	—	15	20	20	—	—
Charleston	W. Va.	1.20	1.17	1.19	—	—	9	11	12	—	—	15	10	<5	—	—
Milwaukee	Wis.	1.19	1.17	1.19	—	—	6	5	5	—	—	20	10	<5	—	—
Laramie	Wyo.	1.00	1.04	1.04	—	—	5	7	7	—	—	10	15	20	—	—

[a] Numbers in parentheses indicate total number of analyses reported during September. The regular monthly sample, taken during the first two weeks of September (before the effect of the Russian atmospheric nuclear weapons testing), is weighted for 15 days and the average of those analyses reported during the last two weeks is also weighted for 15 days to obtain the September average.
Absence of parentheses indicates that one sample was taken prior to the effect of the Russian testing in the atmosphere during September.

[b] Dash indicates that the concentration was reported to be less than the level of detection. The sample was collected prior to the effect of Russian testing.

[c] NA indicates no analyses reported.

average for the month. Some of the strontium-89 and strontium-90 data are based on weekly composites of daily samples taken near the end of September.

The sampling schedule in effect during most of October 1961 was presented in the January 1962 *Radiological Health Data*. With the conclusion of the Soviet Union's 1961 series of atmospheric tests, the iodine-131 levels are more predictable and it becomes necessary for the analytical program to shift to other radionuclides. This need is emphasized by the fact that the analytical procedures become more difficult as the levels of activity become lower and the longer lived nuclides increase in relative importance. Therefore, beginning in December 1961, the following sampling schedule became effective:

1. Six daily sampling stations (St. Louis, Seattle, New York, Chicago, Boston, and New

Orleans) to be maintained so that the pattern of normal decline in iodine-131 content of milk at these points may be carefully studied.

2. Any station in the program, not included in the daily sampling schedule where the iodine-131 level exceeds 100 μμc/liter at the time of sampling, to be placed on a two samples per week schedule until this level drops and remains below 100 for two consecutive weeks.

3. All other sampling stations to be placed on a weekly sampling schedule.

4. A full analysis to be completed on a weekly basis for all samples (stable calcium and potassium, strontium-89, strontium-90, zinc-65, cesium-137, barium-140 and iodine-131). For those stations where samples are collected more often than once a week, the laboratories will composite for the weekly analytical schedule as above, except for those radionuclides immediately determined by gamma scan on each sample as received.

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing would, of course, require an immediate reevaluation and readjustment of the sampling frequency and analytical schedule for this program.

Comparison of the results of the September averages with the second and third quarter averages shows that the September stable calcium, strontium-90, and cesium-137 results are generally within anticipated variations. The limited number of analyses for strontium-89 and barium-140 show only that these nuclides are beginning to appear in pasteurized milk. The iodine-131 levels have shown an increase and the daily results for September were published in *Radiological Health Data*, Volume II, Number 11.

Strontium-90 in Canadian Dried Milk Products

Department of National Health and Welfare, Ottawa, Canada

The following table presents the results of measurements of strontium-90 in Canadian dried milk for the months of April, May, and June, 1961. This table was included in the "Quarterly Report of the Radioactive Fallout Study Program," dated October 1961, published by the Radiation Protection Division of the Department of National Health and Welfare, Ottawa, Canada. Figure 1 shows the sampling locations. The samples were collected by inspectors of the Marketing Division of the Department of Agriculture.

Data for the year of 1960 were published in *Radiological Health Data*, Volume I, Numbers 6 and 9, and Volume II, Numbers 4, 8, and 12.

TABLE 1.—STRONTIUM-90 CONTENT OF CANADIAN DRIED MILK POWDER SAMPLES

[Concentrations in μμc/gm calcium]

Station	Type of milk	April 1961	May 1961	June 1961
Calgary	skim	8.3	9.4	5.8
Charlottetown	skim	[2] NS	NS	NS
Chicoutimi	skim	13.8	12.6	NS
E. Florenceville	skim	13.1	15.2	11.7
Edmonton	skim	9.0	11.0	5.5
Granby	skim	13.3	14.2	11.2
Halifax[1]	skim	7.2	9.1	8.9
La Durantye	skim	9.9	12.7	15.6
London	skim	4.6	3.8	3.6
Megantic	skim	15.0	14.6	14.3
Moncton	buttermilk	8.5	9.5	10.7
Ottawa	skim	4.8	5.8	3.7
Saskatoon	buttermilk	7.0	8.2	5.6
Sussex	skim	10.7	13.5	13.1
Vancouver	skim	10.1	10.8	12.2
Walkerton	skim	4.7	4.9	4.0
Winnipeg	buttermilk	5.6	6.4	4.7
Average		8.8	9.8	8.4

[1] New Station. Natural strontium concentration not yet determined. A factor of 1.06 was used for correction of the sample. The results of all other stations were corrected for natural strontium in the sample. This determination was made by neutron activation at A.E.C.L. Chalk River.

[2] NS = No milk powder manufactured for the month.

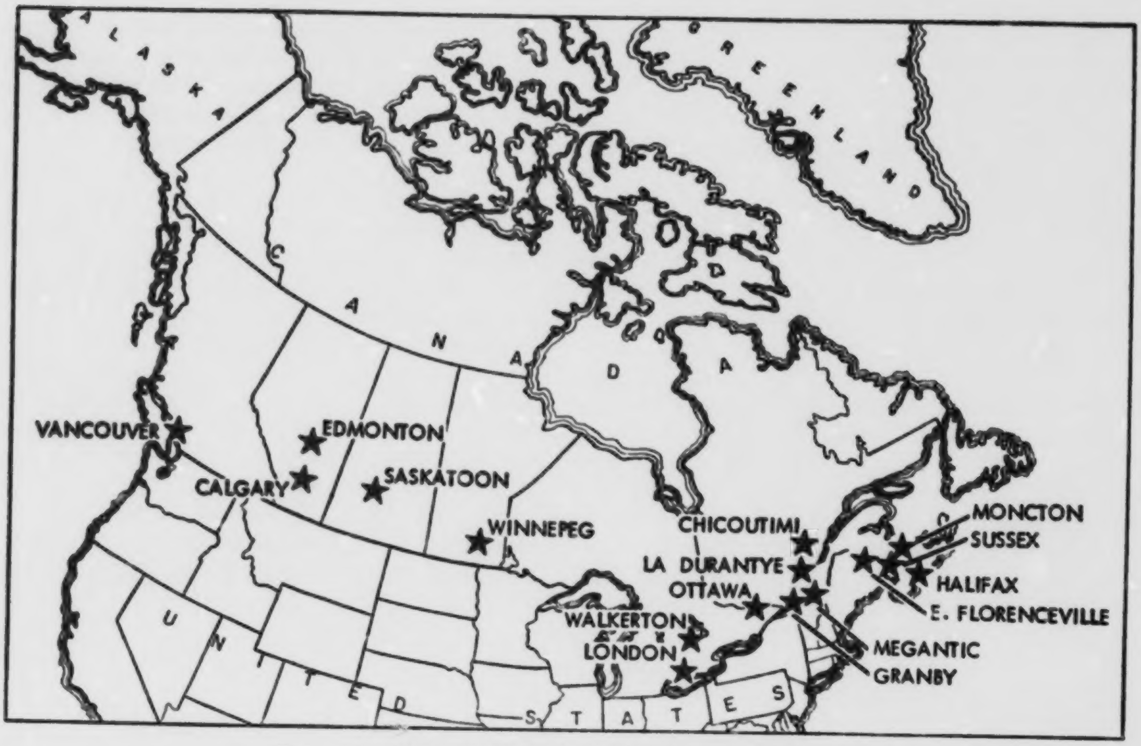
ALASKA
GREENLAND
CANADA
UNITED STATES
VANCOUVER
EDMONTON
CALGARY
SASKATOON
WINNEPEG
CHICOUTIMI
LA DURANTYE
OTTAWA
WALKERTON
LONDON
MONCTON
SUSSEX
HALIFAX
E. FLORENCEVILLE
MEGANTIC
GRANBY

FIGURE 1.—MILK SAMPLING STATIONS IN CANADA

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SECTION IV. — WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

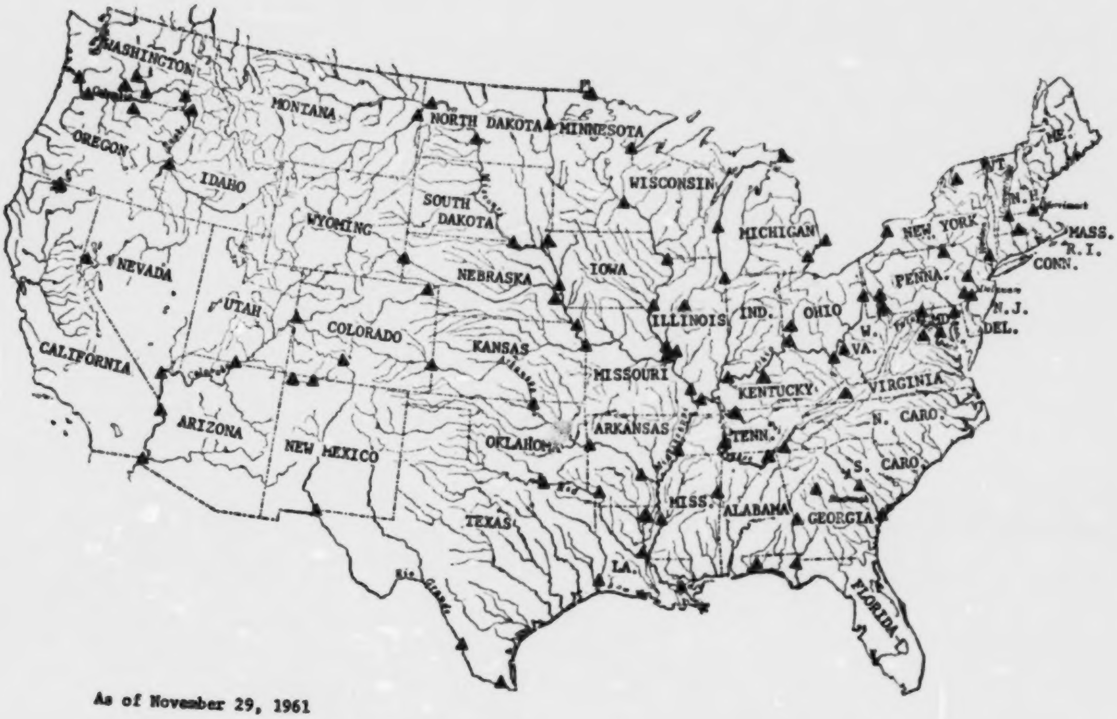
The National Water Quality Network operates under the provision of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and Local agencies, and industrial organizations commenced operations in October 1957. As of December 1, 1961, there were 97 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the USSR has resulted in an increase in radioactivity of surface waters. Preliminary evidence obtained during October 1961 indicates a 5- to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, Northeastern, and Eastern United States. The greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly samples, Alpha determinations were


WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
MINNESOTA
WISCONSIN
SOUTH DAKOTA
WYOMING
NEVADA
UTAH
COLORADO
NEBRASKA
IOWA
MICHIGAN
NEW YORK
VT.
N.H.
ME.
MASS.
R.I.
CONN.
PENNA.
N.J.
DEL.
OHIO
IND.
ILLINOIS
W. VA.
CALIFORNIA
KANSAS
MISSOURI
KENTUCKY
VIRGINIA
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
TENN.
N. CARO.
S. CARO.
TEXAS
MISS.
ALABAMA
GEORGIA
LA.
FLORIDA

As of November 29, 1961

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

reported generally on composites of more than one weekly sample.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely from all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each had one gross alpha determination per month.

The following changes were instituted on September 1, 1961, after the resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease).
2. Beginning with samples collected October 1, 1961, strontium-90 determinations are to be made on a three months composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

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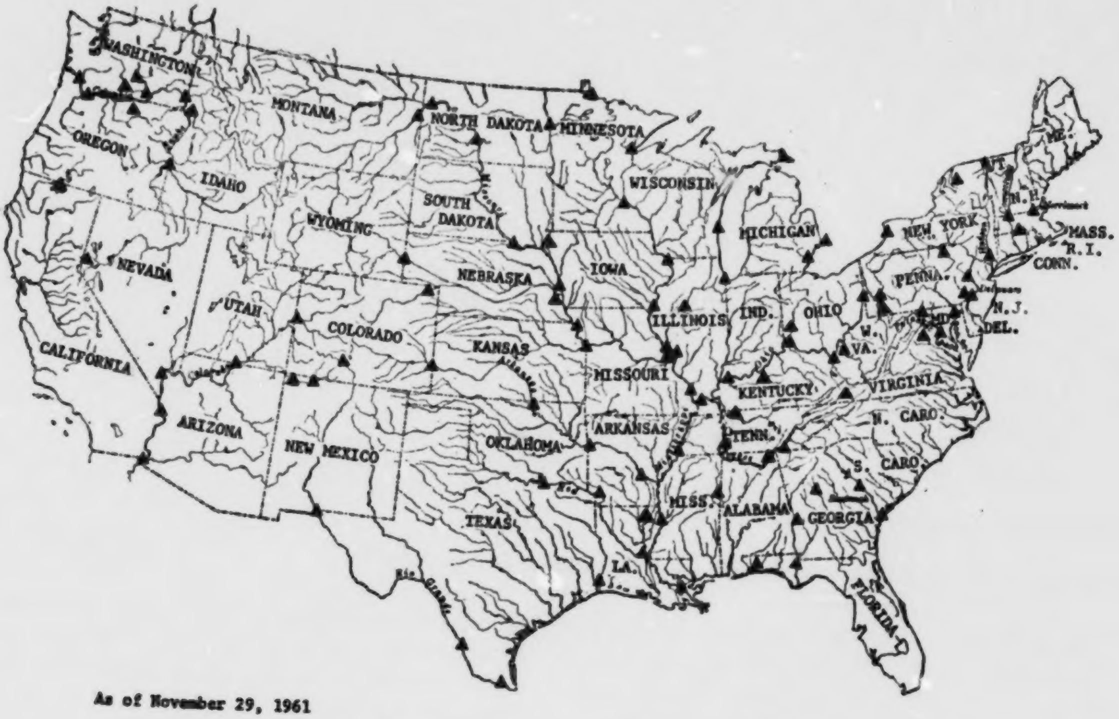
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LA.
WISCONSIN
ILLINOIS
MICHIGAN
IND.
OHIO
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TENN.
MISS.
ALABAMA
GEORGIA
FLORIDA
S. CARO.
N. CARO.
VIRGINIA
W. VA.
PENNA.
NEW YORK
VT.
N.H.
ME.
MASS.
R.I.
CONN.
N.J.
DEL.

As of November 29, 1961

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

reported generally on composites of more than one weekly sample.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely from all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each had one gross alpha determination per month.

The following changes were instituted on September 1, 1961, after the resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease).
2. Beginning with samples collected October 1, 1961, strontium-90 determinations are to be made on a three months composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in $\mu\mu c$/liter]

Station	Quarter ending June 30, 1961	July 1961					
		Beta activity			Alpha activity		
	Strontium-90	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.2	2	6	8	0	<1	<1
Animas River: Cedar Hill, N. Mex	[a]—	4	17	21	1	8	9
Arkansas River:							
Coolidge, Kansas	—	141	4	145	22	16	38
Ponca City, Okla	0.7	—	—	—	—	—	—
Big Sioux River: Sioux Falls, S. Dak	—	6	27	33	1	1	2
Chattahoochie River:							
Atlanta, Ga	0.3	2	1	3	1	0	1
Columbus, Ga	—	2	3	5	0	0	0
Colorado River:							
Loma, Colo	—	47	48	95	2	12	14
Page, Ariz	2.3	—	—	—	—	—	—
Boulder City, Nev	—	1	16	17	<1	9	9
Parker Dam, Calif	—	2	8	10	0	6	6
Yuma, Ariz	—	0	4	4	3	5	8
Columbia River:							
Wenatchee, Wash	—	0	4	4	0	1	1
Pasco, Wash	—	13	199	212	0	0	0
Bonneville Dam, Oreg	—	0	106	106	0	4	4
Clatskanie, Oreg	1.1	10	90	100	1	1	2
McNary Dam, Oreg	—	12	111	123	0	1	1
Connecticut River: Northfield, Mass	—	0	4	4	1	0	1
Cumberland River: Clarksville, Tenn	—	1	3	4	0	0	0
Delaware River:							
Martins Creek, Pa	0.4	2	4	6	0	0	0
Philadelphia, Pa	—	0	4	4	0	0	0
Escambia River: Century, Fla	—	8	5	13	0	0	0
Great Lakes:							
Buffalo, N. Y	—	3	10	13	0	0	0
Port Huron, Mich	—	7	9	16	0	0	0
Milwaukee, Wis	0.3	2	4	6	0	0	0
Gary, Ind	—	1	1	2	0	0	0
Hudson River: Poughkeepsie, N. Y	0.5	2	4	6	—	—	—
Illinois River: Peoria, Ill	—	6	0	6	1	1	2
Kanawha River: Winfield Dam, W. Va	—	2	0	2	1	1	2
Klamath River: Copco, Oreg	0.3	4	1	5	0	0	0
Little Miami River: Cincinnati, Ohio	—	1	8	9	1	<1	1
Merrimack River: Lowell, Mass	—	1	0	1	0	0	0
Mississippi River:							
Minneapolis, Minn	—	0	4	4	1	2	3
Dubuque, Iowa	—	0	7	7	0	1	1
Burlington, Iowa	—	10	8	18	2	1	3
E. St. Louis, Ill	0.5	0	7	7	1	1	2
Cape Girardeau, Mo	—	20	8	28	5	4	9
West Memphis, Ark	—	13	13	26	6	1	7
Delta, La	—	23	12	35	5	0	5
New Orleans, La	0.6	2	12	14	1	0	1
Missouri River:							
Williston, N. Dak	—	8	1	9	5	4	9
Bismarck, N. Dak	0.6	0	9	9	1	3	4
Yankton, S. Dak	—	0	12	12	1	3	4
Omaha, Neb	0.7	22	26	48	3	5	8
St. Joseph, Mo	—	8	29	37	11	4	15
Kansas City, Kans	—	17	19	36	4	3	7
St. Louis, Mo	—	35	10	45	16	1	17
Monongahela River: Pittsburgh, Pa	—	2	6	8	0	1	1
North Platte River: Henry, Neb	—	0	5	5	0	16	16
Ohio River:							
East Liverpool, Ohio	—	1	1	2	0	0	0
Huntington, W. Va	—	3	8	11	0	1	1
Cincinnati, Ohio	—	5	11	16	2	1	3
Louisville, Ky	—	6	3	9	2	<1	2
Evansville, Ind	—	5	4	9	1	0	1
Cairo, Ill	—	6	9	15	3	1	4
Ouchita River: Bastrop, La	—	5	11	16	0	1	1
Potomac River:							
Williamsport, Md	0.8	2	5	7	0	0	0
Great Falls, Md		3	8	11	0	1	1
Platte River: Plattsmouth, Neb	—	11	11	22	5	3	8
Red River, North: Grand Forks, N. Dak	1.5	—	—	—		—	—
Red River, South:							
Index, Ark	—	0	13	13	0	4	4
Denison, Tex	—	0	0	0	0	1	1
Alexandria, La	—	10	11	21	1	0	1
Rio Grande:							
Alamosa, Colo	—	4	10	14	1	3	4
El Paso, Tex	—	4	10	14	6	5	11
Laredo, Tex	—	72	7	79	34	4	38
Brownsville, Tex	0.3	8	21	29	2	4	6
Roanoke River: John H. Kerr Reservoir & Dam, Va	—	2	4	6	<1	0	<1
Sabine River: Ruliff, Tex	0.8	—	—	—	—	—	—
St. Lawrence River: Massena, N. Y	—	0	0	0	1	0	1
Savannah River:							
Port Wentworth, Ga	0.5	7	17	24	0	0	0
North Augusta, S. C	0.5	0	0	0	0	0	0
Snake River:							
Wawawai, Wash	—	0	19	19	0	1	1
Weiser, Idaho	—	1	8	9	0	3	3
South Platte River: Julesburg, Colo	—	42	54	96	6	34	40
Susquehanna River: Conowingo, Md	—	0	16	16	0	0	0
Tennessee River:							
Chattanooga, Tenn	—	4	53	57	—	—	—
Bridgeport, Ala	0.9	3	38	41	0	1	1
Yakima River: Richland, Wash	—	1	10	11	0	2	2
Yellowstone River: Sidney, Mont	0.8	8	13	21	0	4	4

[a] Dash denotes no sample received or no determinations made.

All data reported in table 1 represent the average of all information available for the period indicated. Reported strontium-90 data are the results of determinations on three-month composite samples for a quarter ending in the month shown. The data were determined on analytical schedules in effect till September 1, 1961.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D.C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *J. AWWA 51*, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *J. AWWA 52*, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *J. AWWA, 53*, 704 (1961).

SECTION V. — OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise, but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, NOVEMBER 1961

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Lansing	Mich	0.02
Anchorage	Alaska	0.01	Minneapolis	Minn	0.01
Attu	Alaska	0.01	Jackson	Miss	0.01
Barrow	Alaska	0.01	Pascagoula	Miss	0.01
Cold Bay	Alaska	0.01	Jefferson City	Mo	0.01
Fairbank	Alaska	0.01	Helena	Mont	0.03
Juneau	Alaska	0.02	Lincoln	Nebr	0.01
Kodiak	Alaska	0.01	Trenton	N. J	0.02
Nome	Alaska	0.01	Santa Fe	N. Mex	0.03
St. Paul Island	Alaska	0.02	Albany	N. Y	0.03
Phoenix	Ariz	0.02	Gastonia	N. C	0.02
Little Rock	Ark	0.01	Bismarck	N. Dak	0.01
Berkeley	Calif	0.02	Columbus	Ohio	0.01
Denver	Colo	0.02	Oklahoma City	Okla	0.01
Hartford	Conn	0.01	Ponca City	Okla	0.04
Washington	D. C	0.02	Portland	Oreg	0.02
Jacksonville	Fla	0.01	Harrisburg	Pa	0.01
Miami	Fla	0.01	San Juan	P. R	0.01
Atlanta	Ga	0.03	Providence	R. I	0.02
Agana	Guam	0.02	Columbia	S. C	0.02
Honolulu	Hawaii	0.03	Pierre	S. Dak	0.02
Boise	Idaho	0.02	Nashville	Tenn	0.01
Springfield	Ill	0.01	Austin	Tex	0.01
Indianapolis	Ind	0.01	El Paso	Tex	0.02
Iowa City	Iowa	0.03	Salt Lake City	Utah	0.02
Topeka	Kans	0.02	Richmond	Va	0.02
Frankfort	Ky	0.01	Seattle	Wash	0.01
New Orleans	La	0.02	Madison	Wis	0.01
Baltimore	Md	0.02	Cheyenne	Wyo	0.02
Lawrence	Mass	0.02			

Global Integrals of Strontium-90 in Fallout, January 1958 - December 1960[1]

Kosta Telegadas
U.S. Weather Bureau

The monthly worldwide strontium-90 fallout for the period June 1958-May 1960 as determined from the pot and ion-exchange collectors has been reported in earlier HASL reports (*1, 2, 3*), and the September 1961 *Radiological Health Data.* This article is an expansion of those reports to cover a three year period, January 1958-December 1960.

Monthly collections are continuing, but as of May 1960, because of the low levels of activity, the samples are combined on a two month basis at most sites (*4*). As in earlier reports, two techniques were used in smoothing the data. The first consists of determining the arithmetic average of the strontium-90 deposition for each 10 degrees latitude band and drawing a smooth curve through these values. The second technique attempts to compensate for the climate differences by using the average rainfall in a latitude band.

Smoothed seasonal or bi-monthly latitudinal curves of deposition by the two techniques and for the periods under consideration are shown in figure 1. The curves in figure 1 were integrated to give the fallout in megacuries of strontium-90. The results are shown in table 1 together with those from the periods reported earlier.

It has been reported (*4*) that at four collection sites where the pot and ion-exchange collectors sampled simultaneously, a systematic difference was observed starting with the July 1960 samples. The pot collectors showed a decline in the monthly deposition of strontium-90 while the ion-exchange collectors did not. This systematic difference was attributed to contamination of the resin with strontium-90 in the ion-exchange collector and therefore, a constant value of 0.24 mc/mi^2 was subtracted from the observed values of the ion-exchange sample starting in July 1960. In the period where the constant correction was applied to the ion-exchange collectors more samples were reported as having zero activity than in the earlier period. It may be that the ion-exchange correction is not applicable to all columns and therefore, in this report the analyses from July 1960 on was essentially based on the pot data.

No attempt is made to estimate the reliability of the anlyses. It should be pointed out that it is difficult to evaluate the uncertainties in assuming that the arithmetic average of selected stations is representative of the average value for the whole latitude band and in assuming that the average latitudinal rainfall is the same as that which occurred for the time period under consideration. In the estimation of the total strontium-90 deposition, it should be mentioned that in addition to the uncertainties mentioned above, virtually no samples were taken north of 60° N latitude or south of 40° S latitude. In estimating deposition in these latitude bands a subjective analysis was used where essentially the trend of activity at other latitude bands was extrapolated to higher latitudes.

Between the cessation of large scale nuclear testing in 1958 and the resumption of testing in 1961, a number of papers had been written on the distribution of fallout on the earth's surface. One feature of the surface fallout which has been observed by many is the seasonal variation in the rate of fallout, a maximum in the spring and a minimum in the fall. This seasonal variation has been attributed principally to the seasonal changes in the atmosphere. To show this seasonal variation of surface fallout the bi-monthly and seasonal strontium-90 deposition for the Northern and Southern Hemispheres listed in table 1 was plotted on a time scale and shown in figure 2. It can be seen that in the Northern Hemisphere the spring maximum and fall minimum are clearly indicated. The Southern Hemisphere seasonal effect is not as well marked, which can probably be attributed to several causes. There are few sampling sites in the Southern Hemisphere with virtually no observations south to 40° latitude. If more sampling sites were available the seasonal changes might show up more clearly. Another factor which may help mask seasonal effect are the low levels of activity in

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[1] From *Quarterly Summary Report, HASL 115,* October 1, 1961.

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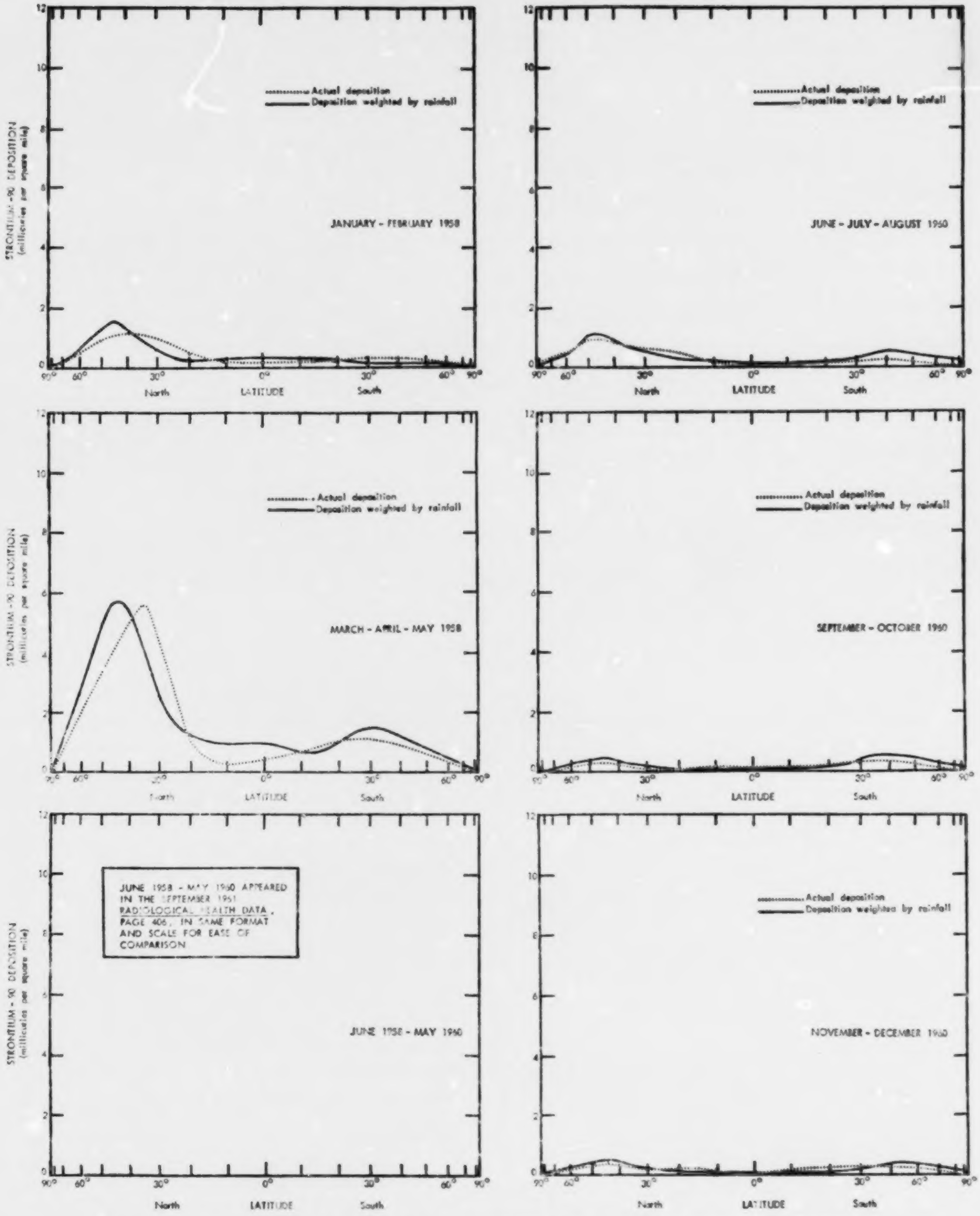

JUNE 1958 - MAY 1960 APPEARED IN THE SEPTEMBER 1961 RADIOLOGICAL HEALTH DATA, PAGE 406, IN SAME FORMAT AND SCALE FOR EASE OF COMPARISON

FIGURE 1.—SEASONAL LATITUDINAL CURVES OF STRONTIUM-90 DEPOSITION (JANUARY–MAY 1958, JUNE–DECEMBER 1960)

TABLE 1.—TOTAL WORLD GROUND DEPOSITION OF STRONTIUM-90, JANUARY 1958–DECEMBER 1960

[Deposition in megacuries]

Period	Method	North latitude			South lat.	Total	Average total
		90°-30°	30°-0°	90°-0° Total	0°-90°		
Jan.-Feb. 1958	Actual deposition	0.04	0.02	0.06	0.02	0.08	0.09
	Deposition weighted by rainfall	0.05	0.02	0.07	0.02	0.09	
Mar.-May 1958	Actual deposition	0.15	0.05	0.20	0.06	0.26	0.29
	Deposition weighted by rainfall	0.18	0.06	0.24	0.08	0.32	
June-Aug. 1958	Actual deposition	0.13	0.05	0.18	0.04	0.22	0.26
	Deposition weighted by rainfall	0.19	0.03	0.22	0.07	0.29	
Sep.-Nov. 1958	Actual deposition	0.06	0.04	0.10	0.07	0.17	0.19
	Deposition weighted by rainfall	0.09	0.02	0.11	0.09	0.20	
Dec. 1958-Feb. 1959	Actual deposition	0.15	0.06	0.21	0.07	0.28	0.29
	Deposition weighted by rainfall	0.16	0.06	0.22	0.07	0.29	
Apr.-May 1959	Actual deposition	0.34	0.12	0.46	0.05	0.51	0.52
	Deposition weighted by rainfall	0.37	0.08	0.45	0.07	0.52	
June-Aug. 1959	Actual deposition	0.16	0.04	0.20	0.03	0.23	0.25
	Deposition weighted by rainfall	0.16	0.04	0.20	0.06	0.26	
Sep.-Nov. 1959	Actual deposition	0.06	0.03	0.09	0.03	0.12	0.12
	Deposition weighted by rainfall	0.04	0.03	0.07	0.05	0.12	
Dec. 1959-Feb. 1960	Actual deposition	0.037	0.026	0.063	0.041	0.104	0.110
	Deposition weighted by rainfall	0.042	0.026	0.068	0.047	0.115	
Mar.-May 1960	Actual deposition	0.056	0.037	0.093	0.033	0.126	0.139
	Deposition weighted by rainfall	0.074	0.037	0.110	0.042	0.153	
June-Aug. 1960	Actual deposition	0.034	0.018	0.052	0.023	0.075	0.079
	Deposition weighted by rainfall	0.034	0.017	0.052	0.029	0.080	
Sep.-Oct. 1960	Actual deposition	0.010	0.007	0.017	0.025	0.042	0.047
	Deposition weighted by rainfall	0.015	0.006	0.021	0.030	0.051	
Nov.-Dec. 1960	Actual deposition	0.011	0.008	0.019	0.021	0.040	0.044
	Deposition weighted by rainfall	0.016	0.007	0.023	0.024	0.047	
Total Jan. 1958-Dec. 1960							2.43

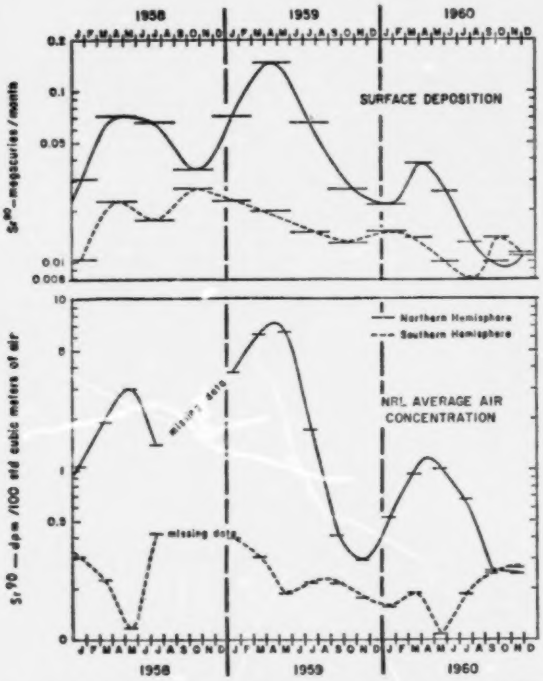

FIGURE 2.—COMPARISON OF SURFACE FALLOUT DEPOSITION TO GROUND LEVEL AIR CONCENTRATIONS

the Southern Hemisphere. Also there may be a real difference in the meteorology of the two hemispheres.

For comparison purposes the Naval Research Laboratory hemispheric ground level air concentrations of strontium-90, which were arrived at by averaging the monthly ground level air concentrations taken along the 80th Meridian (West) are also shown in figure 2 (*5, 6, 7*). In general, both the surface deposition and air concentration data show that the Northern and Southern Hemispheres are out of phase, the levels of activity in the Northern Hemisphere are greater than in the Southern Hemisphere and that beginning in late 1960 the levels of activity in the Southern and Northern Hemispheres are about equal.

REFERENCES

(*1*) Telegadas, K., "Global Integrals of Sr^{90} by the Pot Method," HASL–84, p. 144, April 1, 1960.

(*2*) Telegadas, K., "Global Integrals of Monthly Sr^{90} Fallout, June–November 1959," HASL–95, p. 164, October 1, 1960.

(*3*) Telegadas, K., "Global Integrals of Monthly Sr^{90} Fallout, December 1959–May 1960," HASL–111, p. 159, April 1, 1961.

(*4*) Hardy, E. P., Jr., J. Rivera, and R. Frankel, *Fallout Program*, HASL–113, p. 2, July 1, 1961.

(5) Lockart, L. B., Jr., R. A. Baus, R. L. Patterson, Jr., and A. W. Saunders, Jr., "Radiochemical Analyses of Air-Filter Samples Collected During 1958," NRL Report 5390, October 23, 1960.

(6) Lockhart, L. B., Jr., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black, "Fission Product Radioactivity in the Air Along the 80th Meridian (West) During 1959," NRL Report 5528, August 1960.

(7) Lockhart, L. B., Jr., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black, "Fission Product Radioactivity in the Air Along the 80th Meridian (West) During 1960," NRL Report 5692, August 1961.

Environmental Monitoring in Alaska

Project Chariot
Atomic Energy Commission

In May 1959 the United States Atomic Energy Commission approved a program of environmental studies to be conducted in conjunction with a proposed excavation project using nuclear explosives (Project Chariot, Plowshare Program) at the mouth of Ogotoruk Creek near Cape Thompson, Alaska.

The proposed project, which is under study and for which the detonations have not been approved, would involve the simultaneous detonation of five nuclear devices. Four 20-kiloton devices would be buried to about 400 feet and one 200 kiloton device buried to about 800 feet. The detonation of the four smaller devices would be expected to produce a channel about 900 feet wide and 2,000 feet long, with a basin about 1800 feet in diameter resulting from explosion of the larger device. It is expected that about 95 percent of the fission products will be entrapped underground.

After the USSR resumed testing on September 1, 1961, four fallout monitoring stations were activated at Cape Thompson, Kivalina, Kotzebue and Point Hope, as shown in figure 1.

Table 1 presents the October results. The December 1961 *Radiological Health Data* presented the September results. No water samples were taken during October. The high values for samples taken at Cape Thompson for the period October 8-11 have been re-checked. The decay rates on these samples was very rapid, indicating very fresh fission product material. There is no explanation, at present, for the Cape Thompson levels being so much higher than the other stations during that period.

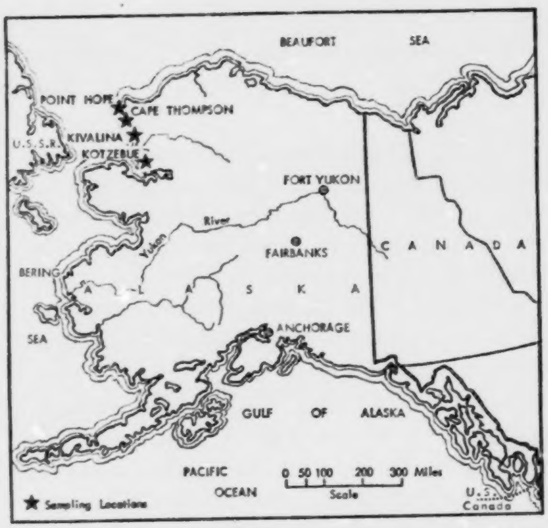

FIGURE 1.—SAMPLING LOCATIONS FOR PROJECT CHARIOT

TABLE 1.—GROSS BETA ACTIVITY IN ALASKAN AIR SAMPLES, OCTOBER 1961

End of sampling period	Cape Thompson		Kivalina		Kotzebue		Point Hope	
	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)
October 1	[a] —	—	6.8	10.5	26.6	16.4	13.0	4.21
2	22.5	6.77	3.3	3.31	21.8	3.96	14.5	17.1
3	—	—	5.0	1.38	23.6	4.04	13.5	1.31
4	24.1	2.62	4.5	2.62	24.1	3.93	14.5	2.36
5	31.5	10.0	5.5	3.20	23.8	2.47	—	—
6	—	—	6.8	2.87	25.1	2.13	15.3	2.69
7	44.7	1.09	2.1	9.8	23.1	2.76	10.2	1.44
8	28.6	2.78	4.2	1.20	24.4	8.75	11.8	3.61
9	24.3	106.0	4.8	0.50	23.7	5.49	11.4	7.98
10	18.2	205.0	4.3	2.48	24.2	5.00	14.2	1.51
11	27.0	273.0	4.5	1.16	24.3	3.52	14.3	1.34
12	24.0	1.81	5.5	3.21	23.9	10.9	14.8	1.96
13	21.7	1.85	4.9	6.14	24.0	1.44	14.3	3.41
14	24.5	2.12	3.2	2.01	24.1	4.83	8.0	3.12
15	—	—	6.5	99.0	24.3	1.10	1.8	20.8
16	40.5	1.58	4.0	5.90	23.5	5.33	8.2	27.1
17	34.9	10.9	5.7	3.16	24.0	7.41	13.2	5.28
18	24.0	4.88	6.2	27.9	26.7	5.34	13.1	24.3
19	—	—	6.7	0.16	20.9	1.12	12.8	0.35
20	24.3	21.0	0.4	20.2	23.9	6.74	13.8	2.20
21	—	—	4.5	1.17	23.7	3.39	10.5	0.38
22	—	—	4.2	1.74	—	—	13.0	1.74
23	23.9	0.59	4.9	0.42	21.2	1.09	13.2	0.21
24	24.0	0.56	5.4	0.18	24.1	0.57	13.6	0.30
25	23.9	0.67	5.7	0.31	24.3	0.22	14.6	0.28
26	23.5	0.20	3.0	1.14	23.6	0.98	12.0	1.72
27	—	—	1.5	0.16	24.1	3.74	12.8	1.05
28	28.0	0.68	3.7	1.00	25.6	7.07	6.8	0.34
29	18.0	1.28	2.5	0.28	23.4	3.05	12.2	0.95
30	29.6	2.66	1.5	3.84	23.2	3.39	12.3	5.07
31	24.3	3.57	—	—	24.0	1.47	12.0	0.89

[a] Dash indicates no sample received.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission transmits to the Public Health Service quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Summaries of the environmental radioactivity data for 19 AEC installations have appeared in *Radiological Health Data* since the November 1960 issue. Summaries follow for Hanford Atomic Products Operation for third and fourth quarters 1960 and first and second quarters 1961; and Portsmouth Area Gaseous Diffusion Plant and Savannah River Plant for first and second quarters 1961.

The measured concentrations of radioactive substances in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurements (NCRP). For the environment near an AEC installation the applicable MPC's are one-tenth of the occupational values for continuous exposure as given in National Bureau of Standards Handbook 69.

TABLE 1.— SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line No.	Radioactive substance	Environmental MPC	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	Arsenic-76	20,000	3,000
2	Chromium-51	2,000,000	80,000
3	Hydrogen-3 (tritium)	3,000,000	200,000
4	Iodine-131	2,000	300
5	Neptunium-239	100,000	20,000
6	Phosphorus-32	20,000	2,000
7	Strontium-90	100	10
8	Thorium-234	20,000	1,000
9	Uranium, natural	20,000	2
10	Zinc-65	100,000	2,000

Another guide by which environmental levels may be evaluated is the Radioactivity Concen-

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tration Guide (RCG) recommended by the Federal Radiation Council. For most nuclides an RCG is numerically equal to the corresponding MPC.

For the purpose of clarity and perspective, a few of the applicable environmental MPC (or RCG) values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 and FRC Report No. 1 should be consulted.

The estabishment of MPC's does not imply that each nuclide may be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, then the sum of all the percent values should not exceed 100%.

Hanford Atomic Products Operation

General Electric Company
Richland, Washington

Third Quarter 1960 Through Second Quarter 1961
Issued October 1961

Previous Coverage in *Radiological Health Data*:

Period covered:	*Issue:*
1959 and first and second quarter 1960	May 1961

During the operation of the plutonium production and research facilities at Hanford, controlled amounts of radioactive wastes are released to the atmosphere, ground, and the Columbia River. This report presents an analysis of data from the environmental sampling program designed to check the effectiveness of the control measures. In addition to the results for the twelve month period covered by this report, some earlier results will be shown for comparison. Figure 1 shows the relationship of the Hanford facilities to the surrounding communities.

Air Wastes Monitoring

Exposures from releases of air-borne contaminants via stacks to the atmosphere were small and are not included in figures 4, 5 and 6. Iodine-131 is the radionuclide of process off-gas origin which is of particular interest. The emission rate for I^{131} released to the atmosphere is shown in figure 2. The local control limit for release of I^{131} is 10 curies per seven days. At the release rate observed, no significant depositions on native vegetation were expected or found.

Routine measurements of I^{131} in air at Richland, North Richland, Pasco, and Benton City indicate that the average concentration in air for the 12 months ending with June of 1961 was less than 0.03 $\mu\mu c$ I^{131}/m^3. A sustained concentration of I^{131} of this magnitude in inspired air would imply an annual exposure to the thyroid of the standard man of about 0.3 mrad.

Concentrations of I^{131} may be several orders of magnitude greater in the thyroid of grazing animals than in their food. Consequently, the radioassay of beef cattle thyroids is useful in the study of effects of low level I^{131} emssions. Occurrences of I^{131} in cattle thyroids from the Pasco slaughterhouse are shown in figure 3. No samples were obtained in June.

Water Waste Monitoring

The principal source of exposure continues to be identified with radionuclides in reactor cooling water discharged to the Columbia River. For individuals whose habits regularly include drinking water from Pasco's public supply, ingesting of local fish and waterfowl, and consuming produce from local farms, an intake of bone-seeking radionuclides is estimated at about 40 per cent of that recommended by the National Committee on Radiation Protection and Measurements (NCRP) as maximum for continuous intake by persons in the neighborhood of controlled areas. The dose of the GI tract from drinking Pasco water for the 12 months ending with June of 1961 is calculated as about 90 mrems, which amounts to 6 percent of the recommended maximum permissible limit.

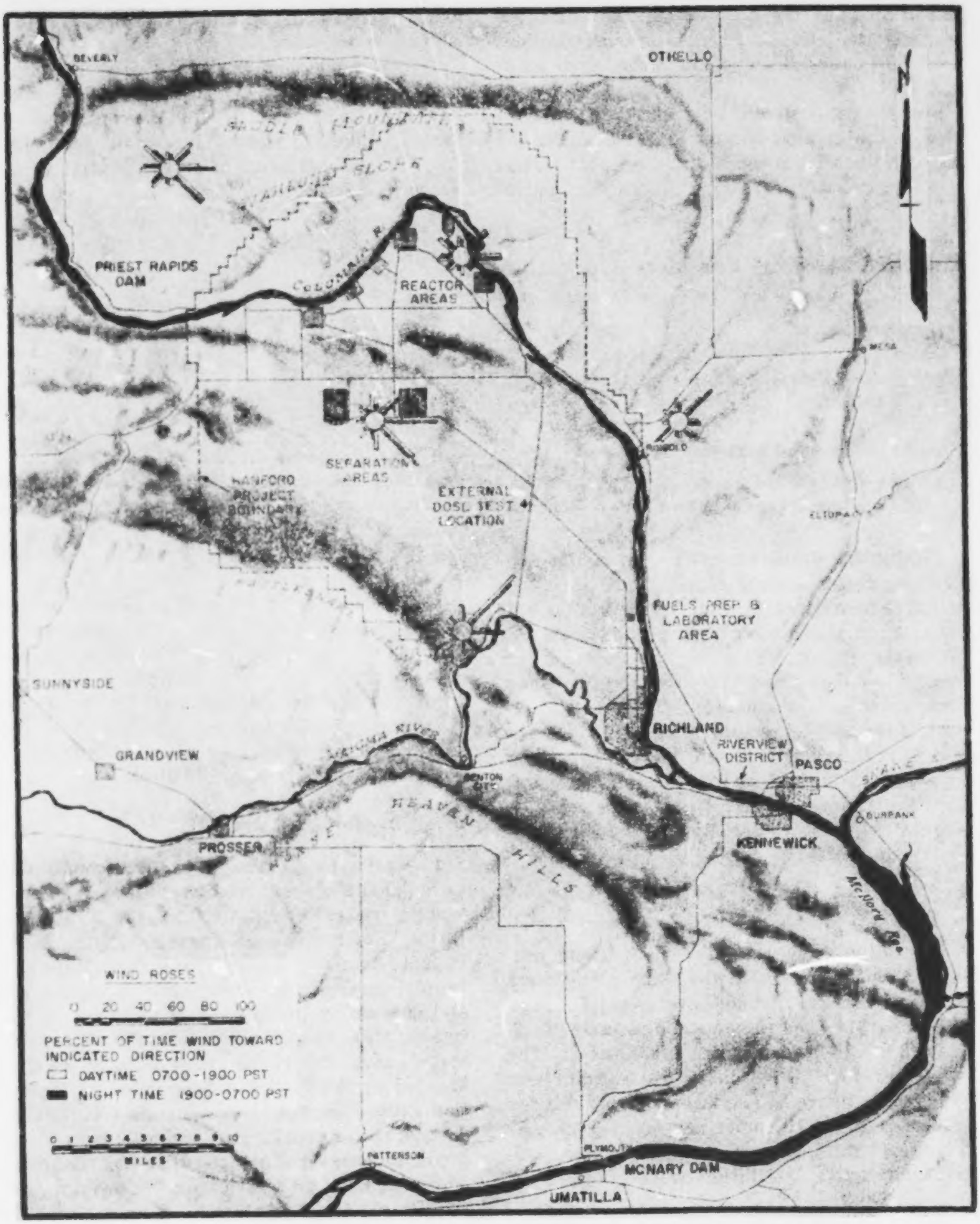
BEVERLY
OTHELLO
SADDLE MOUNTAINS
WAHLUKE SLOPE
COLUMBIA R.
PRIEST RAPIDS DAM
REACTOR AREAS
MESA
RINGOLD
SEPARATION AREAS
HANFORD PROJECT BOUNDARY
EXTERNAL DOSE TEST LOCATION
ELTOPIA
RATTLESNAKE
FUELS PREP & LABORATORY AREA
SUNNYSIDE
RICHLAND
RIVERVIEW DISTRICT
PASCO
SNAKE
GRANDVIEW
YAKIMA RIVER
BENTON CITY
HORSE HEAVEN HILLS
PROSSER
KENNEWICK
BURBANK
McNary Re.
WIND ROSES
0 20 40 60 80 100
PERCENT OF TIME WIND TOWARD INDICATED DIRECTION
DAYTIME 0700-1900 PST
NIGHT TIME 1900-0700 PST
0 1 2 3 4 5 6 7 8 9 10
MILES
PATTERSON
PLYMOUTH
MCNARY DAM
UMATILLA
N

FIGURE 1.—FEATURES OF THE HANFORD OPERATION AND VICINITY

67<

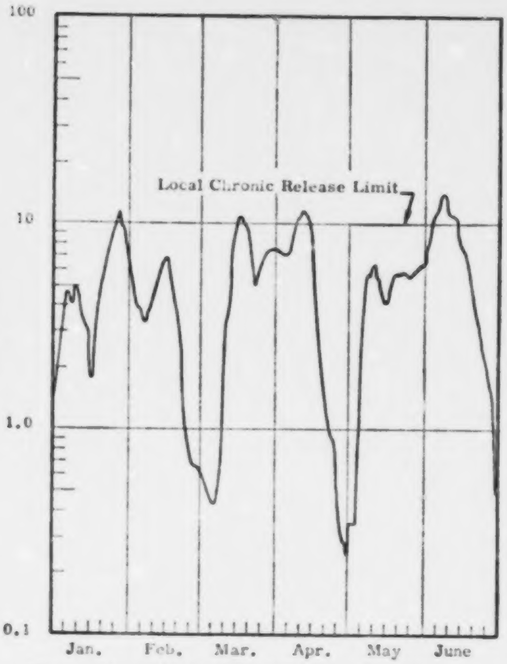

FIGURE 2.—RELEASE OF I^{131} TO THE ATMOSPHERE, 1961

The 1960 estimates of dose received by persons in neighboring communities are represented graphically in figures 4, 5 and 6 for the GI tract, bone, and total body, respectively. In

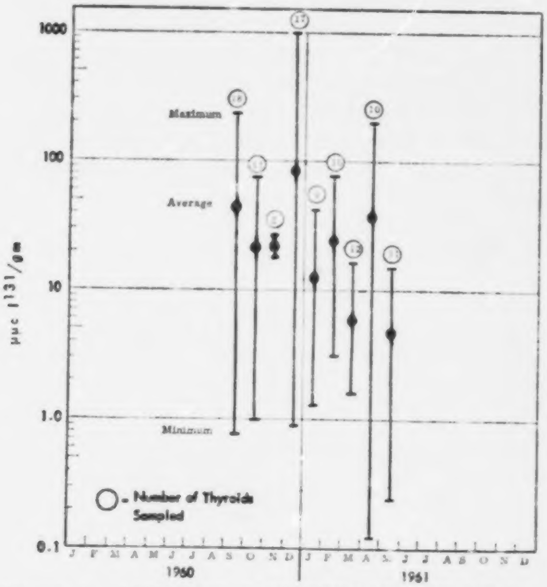

FIGURE 3.—AVERAGE CONCENTRATIONS OF I^{131} IN BEEF CATTLE THYROIDS FROM PASCO SLAUGHTER HOUSE

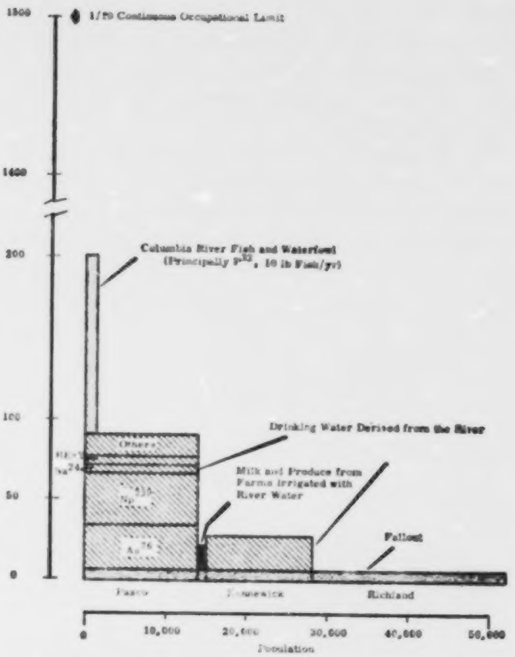

FIGURE 4.—CALCULATED DOSE TO THE HUMAN GI TRACT, 1960

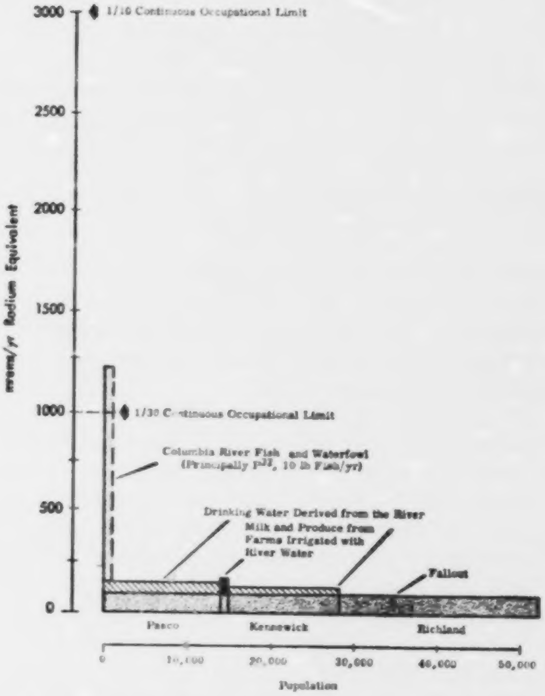

FIGURE 5.—CALCULATED DOSE TO HUMAN BONE, 1960

the figures, the vertical scale is dose in mrems per year and the horizontal scale indicates the number of people involved. Various limits also are indicated and the several sources of exposure are identified.

The principal exposures attributable to Hanford results from ingesting local fish from the Columbia River, drinking water at Pasco and Kennewick, and eating produce from the few farms irrigated with river water. A small contribution to dose in the case of each of the body organs results from worldwide fallout. Figure 6 includes the dose estimated from natural background sources.

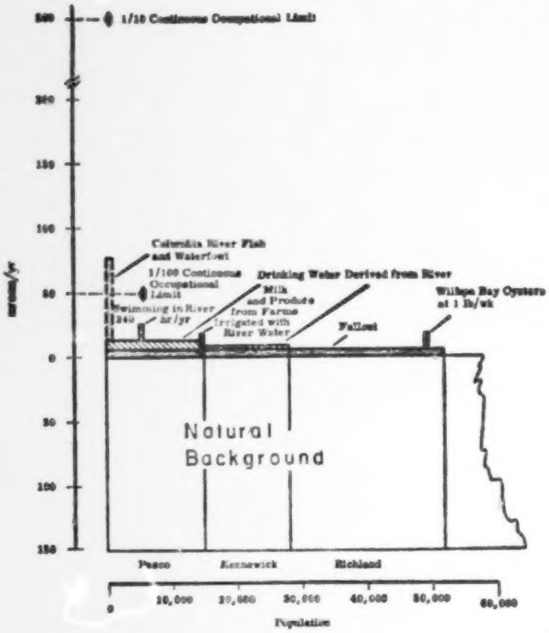

FIGURE 6.—CALCULATED DOSE TO TOTAL BODY OF MAN, 1960

At present, the exposure from fish and waterfowl can only be estimated for hypothetical persons. The illustration is based on consumption of 10 pounds per year of whitefish caught in the Hanford-Ringold area which contained P^{32} in amounts indicated in 1960. While the dose from fish and waterfowl is shown for an individual in Pasco, there may be individuals with similar exposures in Kennewick and Richland.

The data collected over several years on the beta emitters (nearly all P^{32}) in whitefish in the Hanford-Ringold area are presented in figure 7. Current measurements on whitefish include radioassay specifically for P^{32} and several other radionuclides. The concentrations of P^{32} in the fish vary considerably with the season and reach a maximum in late fall. The reduction in the concentration of P^{32} in the second quarter is a reflection of a seasonal trend associated with water temperature and flow rate. Unusually high river flows hampered fish sampling in the Columbia River during June.

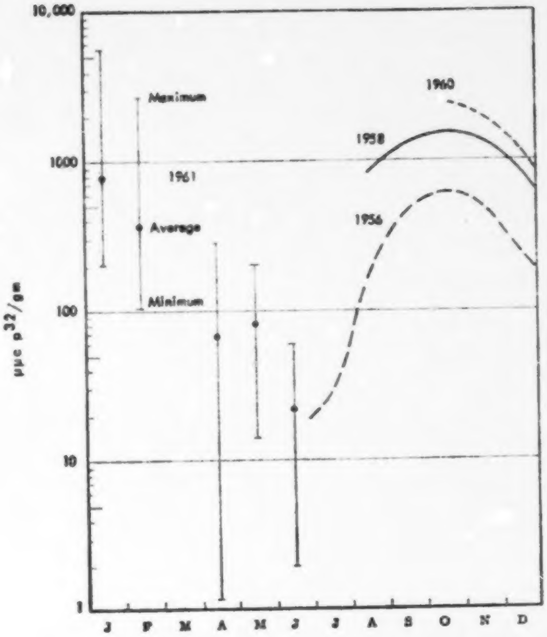

FIGURE 7.—PHOSPHORUS-32 IN COLUMBIA RIVER WHITEFISH, HANFORD FERRY TO RICHLAND

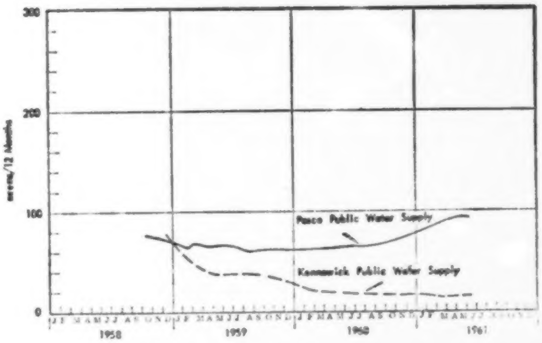

FIGURE 8.—TRENDS IN CALCULATED DOSE TO THE GI TRACT

The 12 months calculated dose for the GI tract from drinking water at Pasco and Kennewick are shown in figure 8. The increasing trend in dose from Pasco sanitary water is considered to be caused primarily by changes in the reactor effluent releases. The dose to Kennewick water drinkers remains at about 15 mrems per year. The smaller dose from Kennewick water is believed to be due to dilution by water from the Yakima River flowing along the Kennewick side of the Columbia River.

The seasonal changes in the concentrations of several of the more important radionuclides in Columbia River water, as measured at Pasco for the last few years, are illustrated in figure 9. The low concentrations in June and July are caused by high water in the Columbia River and are not due to process changes.

Zinc-65 is a reactor effluent radionuclide which persists in the Columbia River to the ocean and is concentrated in certain shellfish, particularly oysters. Oysters from Willapa Bay, Washington, are sampled and analyzed regularly for Zn^{65} and other radionuclides. The average concentration of Zn^{65} in oysters during the first quarter of 1961 was 60 μμc Zn^{65}/gm, and during the second quarter, 90 μμc Zn^{65}/gm. Sustained ingestion of one pound of oysters from Willapa Bay per week for the 12 months ending with June of 1961 would have resulted in about 10 mrems to the total body.

Milk and Produce

Exposure due to ingestion of milk and produce from local farms involves a limited number of people. The Ringold farms and the Riverview District take water from the river below the reactors and some of the radionuclides are traced through the irrigation processes to milk and product. The Ringold farms involve about a dozen people working about 500 acres of land. Fruit and milk are the principal products of these farms with only limited production of vegetables and meat. The Riverview farming area is composed of less than 3000 acres and has about 20 to 30 families. Most of the farms are small with milk, fruit, and some vegetables as major items of produce. Other farming areas in the vicinity of Hanford are not irrigated with Columbia River water taken downstream from the reactors.

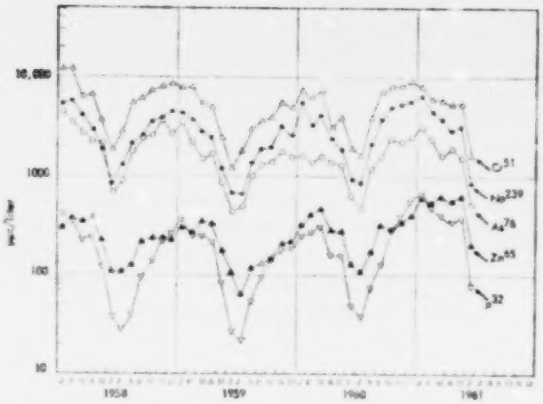

FIGURE 9.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN COLUMBIA RIVER WATER AT PASCO, WASHINGTON

One of the principal routes of intake of radionuclides of reactor origin for the people of Riverview and Ringold is through ingestion of milk. Phosphorus-32 and Zn^{65} are identified in milk from these areas and the milk is sampled and analyzed regularly. The amounts of these radionuclides in milk vary with release rates from the reactors, flow, irrigation practices, and other factors. Radionuclides in milk are the principal source of dose to farmers in figures 4, 5, and 6.

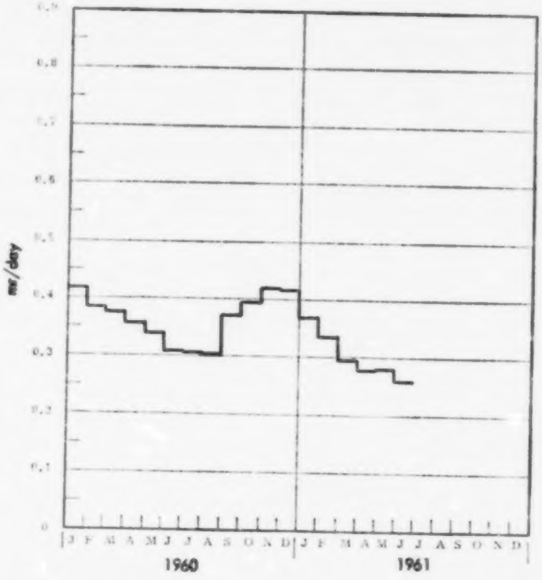

FIGURE 10.—EXTERNAL DOSE-RATE AS MEASURED AT HANFORD EXTERNAL DOSE TEST LOCATION

As a measure of worldwide fallout in the local area, the Sr^{90} content of milk from several local dairies is followed. The measurements are complicated because in many cases the amount is very near the detection limit. The concentrations vary from 2 to 6 μμ/liter.

The observed average concentration of I^{131} in local milk for the second quarter was 60 μμc I^{131}/liter milk. Consumption of one liter per day of such milk for one year would result in an estimated annual dose to the thyroid (for a standard man with a 20-gram thyroid) of less than 0.05 rad.

External Dose Rate

The external dose rate, as measured with ionization chambers at the test location on the Hanford reservation, is illustrated in figure 10. The average dose rate for the 12 months ending with June of 1961 was 0.34 mr per day as compared to 0.40 mr per day for the calendar year 1960.

Portsmouth Area Gaseous Diffusion Plant

Goodyear Atomic Corporation
Portsmouth, Ohio

First and Second Quarters 1961
Issued August 1961

Previous Coverage in *Radiological Health Data*:

Period covered:	*Issue:*
1959 and first quarter 1960	November 1960
Second and third quarters 1960	March 1961
Fourth quarter 1960	August 1961

The gaseous diffusion process for separation of uranium isotopes requires a high degree of control to minimize the release of toxic and radioactive substances to the environment. The most likely radionuclides to be released to the environment are natural uranium (an alpha emitter) and thorium-234 (a beta-gamma emitter) the daughter of uranium-238. Environmental monitoring of alpha and beta gamma activities would therefore detect any concentrations of uranium or thorium-234 significantly above background activities.

Monthly air samples are collected at 15 locations varying from one to six miles from the plant site as shown in figure 11. The average alpha and beta-gamma concentrations in air are reported in table 2.

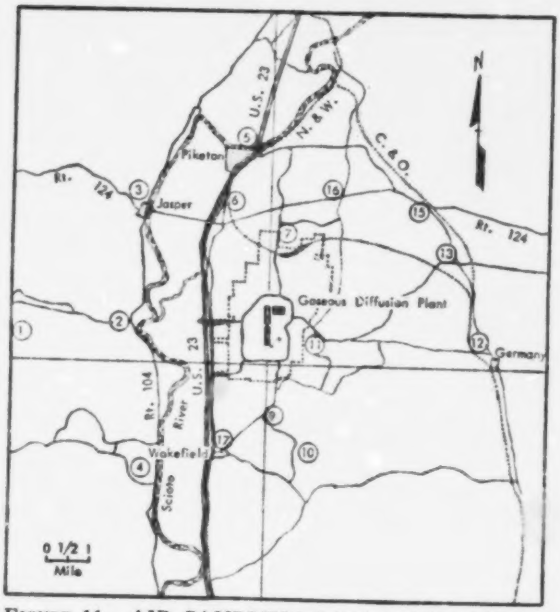

FIGURE 11.—AIR SAMPLING LOCATIONS, PORTSMOUTH GASEOUS DIFFUSION PLANT

TABLE 2.—AVERAGE LEVELS OF RADIOACTIVITY IN THE ENVIRONMENT OF THE PORTSMOUTH PLANT

Basis of measurement	First quarter 1961		Second quarter 1961	
	Number of samples	Concentration	Number of samples	Concentration
Air-alpha[1] concentration	45	0.1 μμc/m³	30	0.1 μμc/m³.
Air-beta-gamma[2] concentration	45	0.2 μμc/m³	30	<0.007 μμc/m³.
Water-alpha[1] concentration	42	13 μμc/liter	41	19 μμc/liter.
Water-beta-gamma[2] concentration	42	21 μμc/liter	41	32 μμc/liter.
Over-all background dose rate	45	0.011 mrad/hour	30	0.013 mrad/hour.

[1] The alpha concentrations may be compared with the MPC values for natural uranium as listed in table 1.
[2] The beta-gamma concentrations may be compared with the MPC values for thorium-234 as listed in table 1.

Water samples are collected monthly at 14 locations within five miles from the plant site. Average alpha and beta-gamma concentrations are given in table 2. The Scioto River showed no significant differences in upstream and downstream concentrations. Some smaller streams and drainage ditches had concentrations as high as 150 $\mu\mu c\ \alpha$/liter and 170 $\mu\mu c\ \beta$-γ/liter. These values are roughly 1 percent of the environmental MPC values listed for natural uranium and thorium in table 1.

The overall background exposure levels are measured at the air sampling locations shown in figure 11.

Although the levels were higher during the second quarter than the first as shown in table 2 the trend has been a steady decrease for the past several years since the cessation of nuclear weapon tests in October 1958.

Savannah River Plant

E. I. du Pont de Nemours
Aiken, South Carolina

First and Second Quarters 1961
Issued September 1961

Previous Coverage in *Radiological Health Data:*

Period covered:	*Issue:*
1959 and First quarter 1960	December 1960
Second and third quarter 1960	May 1960
Fourth quarter 1960	August 1961

The Savannah River Plant (SRP) maintains a continuous monitoring program to determine the concentration of radioactive materials in a 1200 square-mile area outside the plant perimeter. Included are parts of Aiken, Barnwell and Allendale counties in South Carolina and Richmond, Burke and Screven Counties in Georgia. This program, initiated in 1951, prior to startup of plant operations, is carried out by the Health Physics Section of E. I. du Pont de Nemours and Company, prime contractor for operation of the plant for the Atomic Energy Commission.

The regional monitoring data obtained from continuous surveillance of the Savannah River Plant environs are useful both as measures of the effectiveness of plant controls and as evidence of the strict adherence to the recommended Radioactivity Concentration Guide Levels (RCG). Some RCG values are given in table 1.

In most cases, the very low levels of radioactivity in air, water, vegetation, milk and aquatic specimens in the immediate vicinity of the plant (detected by extremely sensitive laboratory and counting techniques) were usually too low to be distinguished from natural background or from bomb debris resulting from global weapons testing activities. Radioiodine levels showed an increase for a brief period in June at several points near the plant boundary in Aiken and Barnwell countries. Release of more than the usual amount of radioiodine from the plant's separations facilities, combined with adverse atmospheric conditions, caused this localized situation. Because radioiodine deposited on vegetation finds its way into milk, a large number of samples of vegetation and milk were collected and analyzed. Results of these analyses were well below the limits established by the National Committee on Radiation Protection.

Atmospheric Monitoring

Weekly air and rainwater samples were collected continuously at 15 monitoring stations, including 5 locations at the plant perimeter and 10 locations which circumscribe an area extending approximately 25 miles from the center of the plant. These stations, forming two concentric circles around the plant, are so spaced such that a significant plant release of radioactivity to the air would be detected regardless of prevailing wind conditions (see figure 12). Additional air monitoring stations were operated at Savannah and Macon, Georgia and at Columbia and Greenville, South Carolina. These four facilities (see figure 13) are at locations so distant (approximately 100 miles from the plant) that the effect of SRP operations is minimal. They serve as "reference

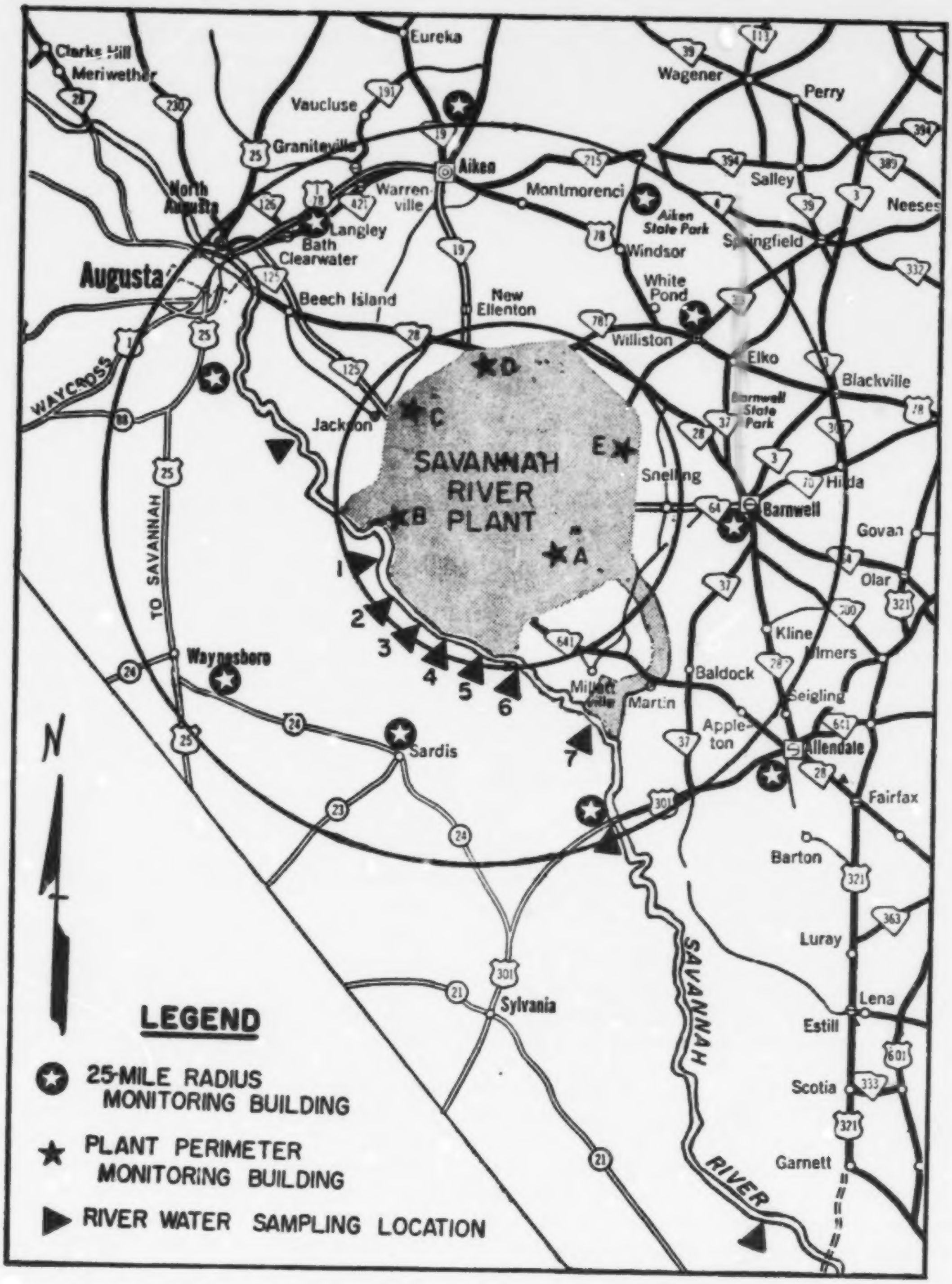
Clarks Hill
Meriwether
Eureka
Wagener
Perry
Vaucluse
Graniteville
Aiken
Montmorenci
Salley
Neeses
North Augusta
Warrenville
Langley
Bath
Clearwater
Aiken State Park
Windsor
Springfield
Augusta
Beech Island
New Ellenton
White Pond
Williston
Elko
Blackville
WAYCROSS
Jackson
Barnwell State Park
SAVANNAH RIVER PLANT
A
B
C
D
E
Snelling
Barnwell
Hilda
Govan
Olar
TO SAVANNAH
Kline
Ulmers
Baldock
Waynesboro
Millett
Martin
Seigling
Appleton
Allendale
Sardis
Fairfax
1
2
3
4
5
6
7
Barton
Luray
Sylvania
Lena
Estill
Scotia
Garnett
SAVANNAH RIVER
N
LEGEND
25-MILE RADIUS MONITORING BUILDING
PLANT PERIMETER MONITORING BUILDING
RIVER WATER SAMPLING LOCATION

FIGURE 12.—ENVIRONMENTAL SAMPLING LOCATIONS, SAVANNAH RIVER PLANT

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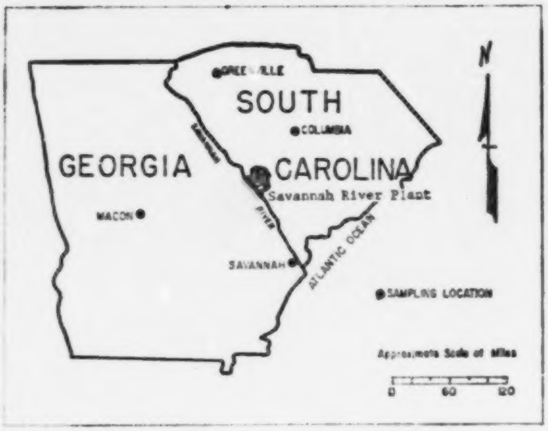
GREENVILLE
SOUTH
CAROLINA
COLUMBIA
GEORGIA
MACON
Savannah River Plant
RIVER
SAVANNAH
ATLANTIC OCEAN
SAMPLING LOCATION
Approximate Scale of Miles
0
60
120
N

FIGURE 13.—DISTANT AIR MONITORING STATIONS, SAVANNAH RIVER PLANT

points" for determining background levels of activity. This system of 19 stations permits a comprehensive surveillance of the atmospheric radioactivity and, in addition, make it possible to differentiate between weapons testing fallout and plant releases. The average concentrations of radioactivity in air and in rainwater are given in tables 3 and 4.

Concentrations of iodine-131 in air observed out to the 25 mile radius circle, and projected concentrations (calculated from the amount of I^{131} released and local meteorological data) are summarized in an isoactivity map, figure 14. Because the calculated and observed data compared favorably, it is assumed that the projected data are representative of actual conditions.

TABLE 3.—RADIOACTIVITY IN AIR

[Average concentrations in μμc/m³]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
First quarter 1961	Plant perimeter	0.0008	0.07	<0.02
	25 mile radius	0.0007	0.06	<0.02
	100 mile radius	0.0009	0.04	NS[1]
Second quarter 1961	Plant perimeter	0.0007	0.07	0.11
	25 mile radius	0.0006	0.07	0.05
	100 mile radius	0.0009	0.1	NS[1]

[1] NS = No sample.

TABLE 4.—RADIOACTIVITY IN RAINWATER

[Average concentrations in μμc/liter]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
First quarter 1961	Plant perimeter	0.5	15	<8
	25 mile radius	0.4	19	<8
Second quarter 1961	Plant perimeter	0.5	22	20
	25 mile radius	0.3	31	15

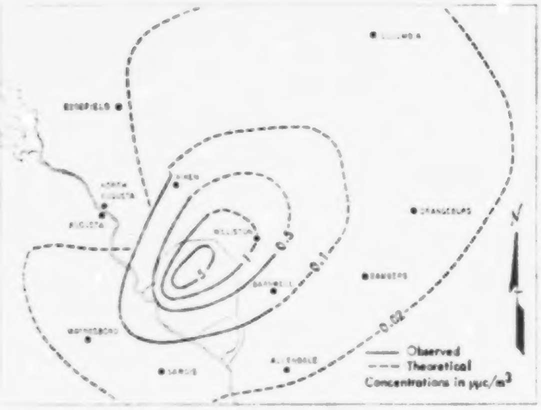
EDGEFIELD
NORTH AUGUSTA
AUGUSTA
AIKEN
WILLISTON
BARNWELL
ORANGEBURG
BAMBERG
ALLENDALE
WAYNESBORO
3
1
0.3
0.1
0.02
N
Observed
Theoretical
Concentrations in μμc/m³

FIGURE 14.—ISOACTIVITY MAP OF IODINE-131 CONCENTRATIONS IN AIR, JUNE 1–7, 1961

Food

Fresh eggs collected during June 1961 contained an average of 33 μμc I^{131}/egg. A suggested guide for I^{131} in eggs is 160,000 μμc/egg[1]. Peaches obtained from a farm several miles north of Aiken showed no evidence of I^{131}.

Milk

Milk samples were collected weekly from dairies and farms in Aiken, North Augusta,

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[1] Horton, J. H., E. I. du Pont de Nemours and Company, Savannah River Plant, Aiken, S.C. *Suggested MPC Values for Radioiodine Isotopes in* **Foods**, presented at the Health Physics Society Annual Meeting, Boston, Massachusetts, June 1960.

TABLE 5.—RADIOACTIVITY IN MILK

[Average concentrations in μμc/liter]

Type of test	First quarter 1961	Second quarter 1961
Tritium (H^3	4,000	7,000
Iodine-131	<11	60
Strontium-90:		
Single cow samples	20	30
Local dairies	12	12
Major distributors	12	13

Snelling, Talatha, and Langley, South Carolina and analyzed for tritium (H^3) and radioiodine content. Strontium-90 content of locally produced milk is determined quarterly. In addition to the milk sampling locations mentioned previously, milk from Williston and Cope, South Carolina and Waynesboro and Sylvania, Georgia was sampled and analyzed. Average concentrations of H^3, I^{131}, and Sr^{90} in milk are given in table 5. The Sr^{89}/Sr^{90} ratio determined for a single-cow sample with a high concentration of 51 μμc/liter, showed it to be aged material and not attributable to SRP.

Special milk samples from 48 individual farms and dairies in the vicinity of the plant were collected early in June. Analyses showed a wide distribution in iodine-131 concentration. The histogram in figure 15 shows the frequency distribution of the 48 farms or dairies in different I^{131} concentration ranges.

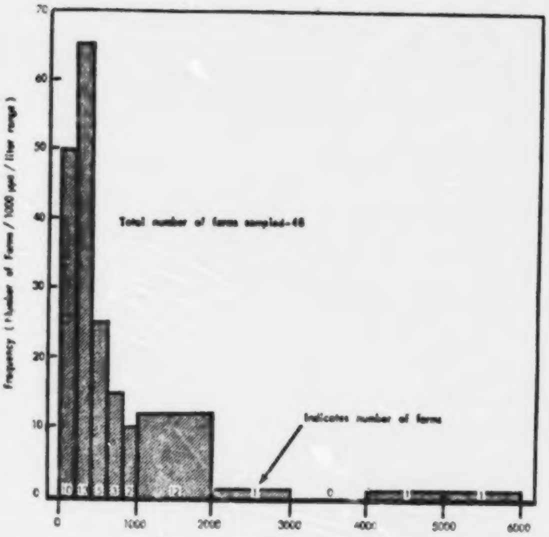

FIGURE 15.—DISTRIBUTION OF MILK SAMPLES IN VARIOUS IODINE-131 CONCENTRATION RANGES

Water Monitoring

Communities in the vicinity of SRP obtain sanitary water from deep wells or surface streams. Public water samples are collected monthly from 14 surrounding towns. Savannah River water is sampled continuously at seven locations. Six of the locations are shown in

TABLE 6.—RADIOACTIVITY IN WATER

[Average concentrations in μμc/liter]

Period	Source of samples	Alpha	Nonvolatile beta	H^3	Sr^{90}
First quarter 1961	Public water supplies	0.8	5	—	—
	Savannah River water:				
	3 miles upstream	0.3	5	4,000	0.3
	10 miles donwstream	0.2	21	13,000	0.6
Second quarter 1961	Public water supplies	1.1	6	—	—
	Savannah River Water:				
	3 miles upstream	0.3	7	4,000	0.3
	10 miles downstream	0.3	31	13,000	0.5

TABLE 7.—RADIOACTIVITY IN VEGETATION (BERMUDA GRASS)

[Average concentrations in μμc/gm]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
First quarter 1961	Plant perimeter	0.23	11	<0.6
	25 mile radius	0.19	8	<0.6
Second quarter 1961	Plant perimeter	0.12	16	3
	25 mile radius	0.15	14	3

figure 12; the seventh is 60 miles downstream from the plant.

Quarterly average concentrations of alpha and beta activity in public and Savannah River water is presented in table 6.

Vegetation

Bermuda grass was selected for analysis of vegetation because of its importance as a pasture grass for dairy herds and its availability during all seasons of the year. Monthly samples are collected at the 15 air monitoring locations shown in figure 12. Quarterly average concentrations of alpha, beta, and I^{131} are presented in table 7.

Special samples of Bermuda grass were collected on June 5 in order to check the extent of I^{131} deposition. Radioiodine concentrations in grass are shown in figure 16.

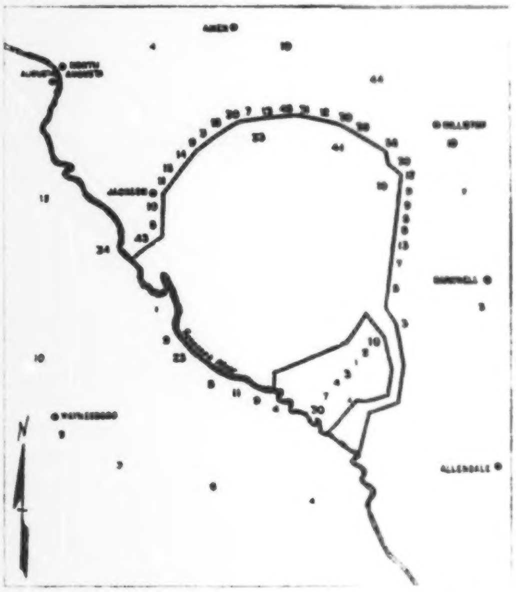

FIGURE 16.—IODINE-131 CONCENTRATIONS ($\mu\mu c/m^3$) IN BERMUDA GRASS IN THE VICINITY OF SAVANNAH RIVER PLANT, JUNE 5, 1961

Gamma Radiation Levels

Environmental gamma radiation dose rates are measured continuously at each of the 15 air monitoring stations shown in figure 12. The average dose rates at the perimeter were 0.32 and 0.29 mr per 24 hours for first and second quarters respectively. The levels at 25 mile radius for the two quarters were essentially the same—0.31 and 0.36 mr per 24 hours. This is slightly less than the North American average for January 1961 (0.42 mr/24 hr) as determined by the PHS Radiation Surveillance Network. (Refer to *Radiological Health Data* Volume II, Number 6.)

Estimated Exposure From the I^{131} Release

External Dose: The maximum off-plant dose rate from external sources to the whole body or to the gonads due to the release was calculated to be 0.0023 mrem/week for a person who continuously remained at the northeast plant boundary 168 hours per week. The Internation Commission on Radiological Protection recommends a weekly limit of 3.2 mrem/week (base on 5 rem per 30 years) for population at large.

Internal Dose: Based on the average concentration of I^{131} in milk from 41 farms and dairies on June 5 and June 6, consumption of this milk may have resulted in a thyroid exposure of 23 mrem. This exposure integrated over a period of a year averages 0.5 mrem/week.

Contributions to the internal dose to man from inhaled air, drinking water or consumption of the other foods were less than 10 percent of the dose resulting from I^{131} in milk.

Announced Nuclear Detonations

Radiological Health Data, Volume II, Numbers 10, 11, and 12, and Volume III, Number 1, published the dates of the Union of Soviet Socialist Republics and the United States announced nuclear detonations through January 1, 1962. The following table gives information on the subsequent tests reported through February 1, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton yield); low-intermediate to mean between a nominal and one megaton yield.

ANNOUNCED U.S. DETONATIONS

Test number	Location	Date	Size	Type of test
10	Nevada Test Site	January 9	Low yield	Underground
11	Nevada Test Site	January 18	Low yield	Underground
12	Nevada Test Site	January 30	Low yield	Underground

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RADIOLOGICAL HEALTH DATA

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, it consisted of 45 stations at urban locations operated by State and local health department personnel, except for 2 stations which were operated by Public Health Service personnel. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the network was expanded over a period of a few months to 64 stations (see figure 1).

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Daily air samples are collected continuously by a high volume air sampler with a carbon-loaded cellulose dust filter. In addition to the particulates retained on the filter, some gaseous fission products are adsorbed by the carbon. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D. C., for a more refined measurement using a thin-window proportional counter. Table 1 presents the monthly summary report of fission product gross beta concentrations in surface air during December 1961.

Continuous precipitation samples are taken at each station over daily sampling periods, using locally-made funnels having collection areas of 0.4 square meter. One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples.

The results in tables 2 and 3 are the monthly summations of the daily precipitation (mm) and the associated gross beta activity ($\mu\mu c/m^2$) for October and November 1961. Overall average gross beta concentrations in $\mu\mu c$/liter for each month's total precipitation may be calculated directly from the data, which yield the dimensionally desired results when activities are divided by the appropriate precipitation totals, i.e.,

$$\text{Average concentration } (\mu\mu c/\text{liter}) = \frac{\text{Activity } (\mu\mu c/m^2)}{\text{Total precipitation (mm)}}$$

When the activity of a given daily sample was too low for reliable measurement, an activity representing the minimum level of detection was included in the monthly summation. In the event that the sum of such values is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a "less than" (<) sign.

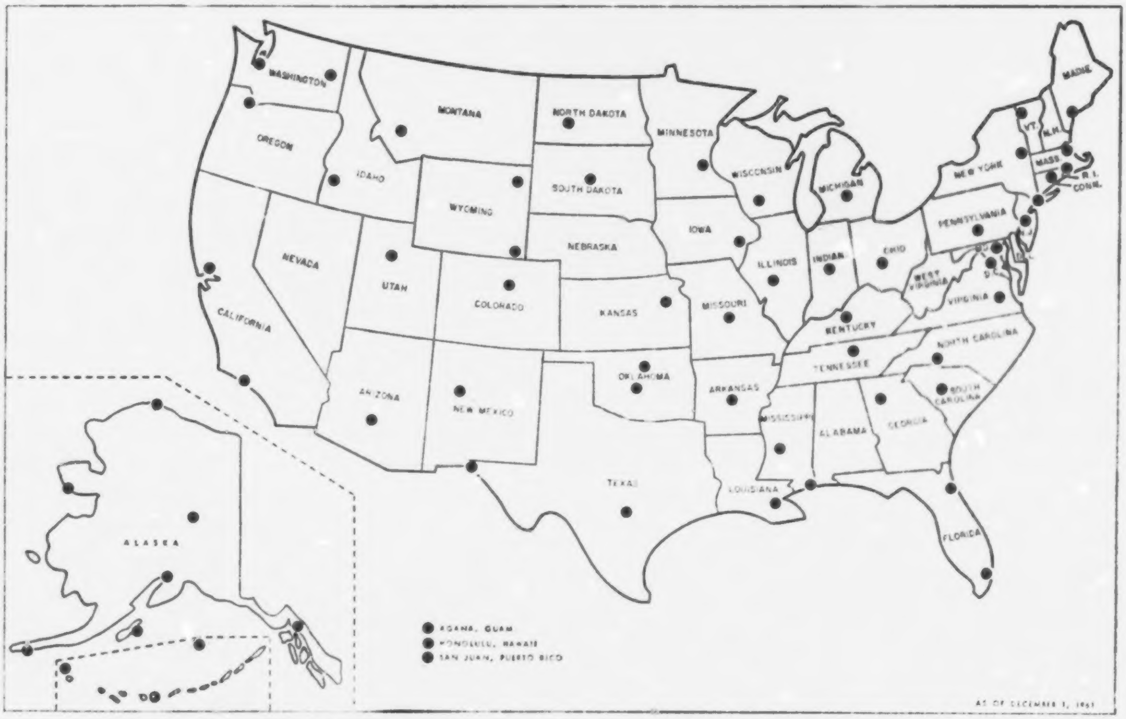
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MISSISSIPPI
MICHIGAN
INDIANA
KENTUCKY
TENNESSEE
ALABAMA
OHIO
GEORGIA
FLORIDA
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
PENNSYLVANIA
NEW YORK
VT.
N.H.
MAINE
MASS.
R.I.
CONN.
D.C.
ALASKA
AGANA, GUAM
HONOLULU, HAWAII
SAN JUAN, PUERTO RICO
AS OF DECEMBER 1, 1961

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR, GROSS BETA DETERMINATIONS, DECEMBER 1961

[Concentrations in $\mu\mu c/m^3$]

Station location		Number samples	Maximum	Minimum	Average[1]
City	State				
Adak	Alaska	27	8.6	<0.10	5.0
Anchorage	Alaska	31	11	0.19	6.0
Attu	Alaska	26	12	0.15	3.7
Cold Bay	Alaska	31	10	0.62	4.3
Fairbanks	Alaska	16	9.8	1.3	5.4
Juneau	Alaska	26	18	<0.10	4.7
Kodiak	Alaska	28	18	0.10	5.8
Nome	Alaska	27	11	0.19	5.4
Point Barrow	Alaska	31	7.0	1.7	4.0
St. Paul Island	Alaska	10	5.5	0.19	2.7
Phoenix	Ariz.	28	32	3.6	14.0
Little Rock	Ark.	28	11	0.64	5.3
Berkeley	Calif.	28	26	1.6	9.6
Los Angeles	Calif.	25	40	4.7	15
Denver	Colo.	26	32	4.1	15
Hartford	Conn.	28	11	1.3	4.9
Washington	D. C.	31	13	0.18	6.5
Jacksonville	Fla.	28	22	2.1	13
Miami	Fla.	28	19	2.3	9.9
Atlanta	Ga.	31	19	0.66	7.3
Agana	Guam	26	5.2	0.60	2.5
Honolulu	Hawaii	27	7.2	1.2	2.9
Boise	Idaho	27	15	3.2	9.2
Springfield	Ill.	31	10	2.2	5.7
Indianapolis	Ind.	28	14	1.4	5.7
Iowa City	Iowa	30	9.7	1.9	4.5
Topeka	Kans.	28	6.2	2.1	4.1
Frankfort	Ky.	28	18	1.5	7.0
New Orleans	La.	28	15	1.2	7.4
Augusta	Maine	17	8.8	1.2	5.0
Baltimore	Md.	31	12	0.19	5.3
Lawrence	Mass.	28	11	1.1	4.4
Lansing	Mich.	29	15	2.3	7.7
Minneapolis	Minn.	29	9.2	2.0	4.7
Jackson	Miss.	25	16	1.0	6.1
Pascagoula	Miss.	16	17	3.4	9.8
Jefferson City	Mo.	28	15	1.1	5.1
Helena	Mont.	31	14	2.9	7.1
Lincoln	Nebr.	[illegible]	5.5	2.0	4.1
Trenton	New Jersey	25	11	0.58	4.2
Santa Fe	N. Mex.	28	27	2.5	12
Albany	N. Y.	27	15	0.96	5.0
New York	N. Y.	15	20	2.5	8.4
Gastonia	N. C.	28	21	0.32	6.5
Bismarck	N. Dak.	28	7.6	2.3	4.8
Columbus	Ohio	27	20	1.9	7.8
Oklahoma City	Okla.	27	15	1.6	7.4
Ponca City	Okla.	26	16	1.4	4.3
Portland	Oreg.	27	10	0.39	5.6
Harrisburg	Pa.	27	12	0.65	5.3
San Juan	P. R.	20	13	0.94	3.7
Providence	R. I.	28	13	1.7	5.9
Columbia	S. C.	26	13	1.3	6.8
Pierre	S. D.	31	12	2.7	5.9
Nashville	Tenn.	29	18	0.47	7.3
Austin	Tex.	27	12	0.32	6.6
El Paso	Tex.	27	19	1.0	10
Salt Lake City	Utah	28	15	2.3	9.1
Richmond	Va.	29	24	0.35	5.7
Seattle	Wash.	28	5.2	0.19	2.4
Madison	Wis.	28	15	2.1	5.5
Cheyenne	Wyo.	28	33	1.1	10
Sundance	Wyo.	3	7.8	3.0	5.5
Network average					6.5

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

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TABLE 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, OCTOBER 1961

Station location		Total precipitation (millimeters)	Activity (μμc/m²)	Station location		Total precipitation (millimeters)	Activity (μμc/m²)
City	State			City	State		
Anchorage	Alaska	53.1	153,000	Jefferson City	Missouri	69.1	143,000
Fairbanks	Alaska	27.3	92,400	Helena	Montana	1.00	8,600
Juneau	Alaska	403.0	1,110,000	Santa Fe	New Mexico	25.1	6,900
Kodiak	Alaska	[a]—	—	Albany	New York	33.2	73,700
Little Rock	Arkansas	3.72	6,100	Oklahoma City	Oklahoma	54.1	<26,400
Berkeley	California	2.04	—	Ponca City	Oklahoma	74.1	159,000
Denver	Colorado	5.17	54,700	Portland	Oregon	70.6	545,000
Hartford	Connecticut	50.0	43,100	Harrisburg	Pennsylvania	17.5	24,500
Washington	D. C.	61.6	208,000	San Juan	Puerto Rico	9.37	<3,300
Jacksonville	Florida	28.4	<9,100	Providence	Rhode Island	77.2	118,000
Honolulu	Hawaii	50.7	<22,400	Columbia	South Carolina	15.5	18,300
Boise	Idaho	58.3	307,000	Pierre	South Dakota	17.1	61,000
Springfield	Illinois	71.2	237,000	Nashville	Tennessee	6.75	—
Indianapolis	Indiana	25.1	53,200	Austin	Texas	20.4	<11,700
Iowa City	Iowa	73.4	75,100	El Paso	Texas	1.53	5,800
Topeka	Kansas	115.6	<69,800	Salt Lake City	Utah	53.3	327,000
New Orleans	Louisiana	127.1	236,000	Richmond	Virginia	97.6	125,000
Lawrence	Massachusetts	57.2	128,000	Seattle	Washington	54.2	274,000
Lansing	Michigan	55.0	111,000	Madison	Wisconsin	88.4	114,000
Minneapolis	Minnesota	92.0	173,000	Cheyenne	Wyoming	10.1	49,000
Pascagoula	Mississippi	103.0	<36,200				

[a] Dash denotes no sample received.

TABLE 3.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, NOVEMBER 1961

Station location		Total precipitation (millimeters)	Activity (μμc/m²)	Station location		Total precipitation (millimeters)	Activity (μμc/m²)
City	State			City	State		
Adak	Alaska	—[a]	—	Minneapolis	Minnesota	29.8	141,000
Anchorage	Alaska	10.2	—	Jackson	Mississippi	76.3	—
Attu	Alaska	—	—	Pascagoula	Mississippi	—	—
Cold Bay	Alaska	—	—	Jefferson City	Missouri	53.8	93,300
Fairbanks	Alaska	8.62	97,700	Helena	Montana	17.9	167,000
Juneau	Alaska	219.0	988,000	Lincoln	Nebraska	5.62	—
Kodiak	Alaska	—	—	Trenton	New Jersey	—	—
Nome	Alaska	—	—	Santa Fe	New Mexico	22.7	60,000
Point Barrow	Alaska	—	—	Albany	New York	73.0	133,000
St. Paul Island	Alaska	—	—	New York	New York	—	—
Phoenix	Arizona	—	—	Gastonia	North Carolina	60.5	77,800
Little Rock	Arkansas	243.1	168,000	Bismarck	North Dakota	—	—
Berkeley	California	102.3	226,000	Columbus	Ohio	37.7	29,000
Los Angeles	California	67.6	238,000	Oklahoma City	Oklahoma	24.7	8,600
Denver	Colorado	18.6	39,000	Ponca City	Oklahoma	89.1	206,000
Hartford	Connecticut	73.2	212,000	Portland	Oregon	83.3	336,000
Washington	D. C.	46.9	109,000	Harrisburg	Pennsylvania	27.3	56,200
Jacksonville	Florida	27.8	35,600	San Juan	Puerto Rico	16.9	13,600
Atlanta	Georgia	51.4	80,300	Providence	Rhode Island	74.0	309,000
Honolulu	Hawaii	98.0	<88,800	Columbia	South Carolina	26.8	79,000
Boise	Idaho	24.6	224,000	Pierre	South Dakota	—	—
Springfield	Illinois	33.9	—	Nashville	Tennessee	104.3	2,400
Indianapolis	Indiana	77.6	134,000	Austin	Texas	57.2	87,700
Iowa City	Iowa	143.7	224,000	El Paso	Texas	33.8	134,000
Topeka	Kansas	58.5	215,000	Salt Lake City	Utah	23.5	70,800
Frankfort	Kentucky	—	—	Richmond	Virginia	48.4	97,000
New Orleans	Louisiana	179.1	<149,000	Seattle	Washington	79.6	238,000
Baltimore	Maryland	—	—	Madison	Wisconsin	121.8	205,000
Lawrence	Massachusetts	63.5	268,000	Cheyenne	Wyoming	4.6	64,400
Lansing	Michigan	50.5	169,000	Sundance	Wyoming	—	—
				Agana	Guam	—	—

[a] Dash denotes no sample received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Robert A. Taft Sanitary Engineering Center, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air at Cincinnati, Ohio. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon–222 (a.m.) concentrations have been corrected for any radon–220 daughter interferences. Radon–222 (p.m.) concentrations are derived from alpha measurements made in

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, NOVEMBER 6–DECEMBER 1, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m.[a] ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
November 6	0800	71.7	88.4	240	100	1.7	5.58
7	0800	24.0	29.4	480	140	3.3	1.58
8	0810	24.1	29.3	260	100	2.5	3.90
9	0801	23.8	28.8	340	130	2.7	5.30
13	0815	96.2	112.5	730	240	5.8	10.26
14	0810	23.9	28.8	250	370	1.6	10.50
15	0820	24.1	28.9	370	300	1.7	2.26
16	0800	23.6	27.9	120	140	1.4	3.10
17	0800	23.9	28.1	110	70	0.4	10.08
20	0800	71.9	84.3	160	60	1.6	1.28
21	0810	24.1	28.8	550	100	2.2	3.24
22	0800	23.8	28.1	300	280	2.2	3.91
24	0800	47.9	68.1	220	190	0.9	8.32
27	0800	71.9	83.0	280	140	2.3	6.35
28	0805	24.0	27.9	330	80	1.4	6.89
29	0805	23.9	27.6	610	100	3.9	3.15
30	0810	24.0	27.6	570	120	3.6	2.93
December 1	0800	23.8	27.6	510	200	4.4	4.34
Average				360	160	2.6	5.7
Range of counting errors (2σ)							
Maximum				48	30	0.8	0.2
Minimum				23	14	0.3	0.1

[a] Sample period and volume does not apply to this column.

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TABLE 2.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, DECEMBER 4–29, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m.[a] ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
December 4	0807	72.0	82.2	330	100	5.2	13.98
5	0800	23.8	27.5	220	100	1.4	7.68
6	0807	24.0	27.9	320	110	2.7	6.25
7	0800	23.8	27.8	180	120	1.5	4.70
8	0808	24.1	28.4	190	130	1.4	4.19
11	0803	71.8	83.3	220	240	1.2	3.44
12	0805	24.0	27.9	220	260	1.3	1.87
13	0810	24.0	28.0	140	100	0.8	5.80
14	0805	23.9	28.0	290	150	2.5	4.20
15	0800	23.9	28.1	370	260	1.2	4.91
18	0810	72.1	84.2	280	290	0.9	3.24
19	0815	24.0	27.9	280	190	0.9	0.98
20	0800	23.7	27.6	70	60	0.8	2.72
21	0805	24.0	28.4	90	120	0.5	6.49
22	0815	24.1	28.5	370	190	1.3	5.13
26	0802	95.7	111.7	150	150	1.2	5.57
27	0820	24.3	28.5	120	200	1.2	12.64
28	0800	23.6	27.8	240	220	0.8	4.02
29	0800	23.9	30.3	140	140	0.7	2.55
Average				226	172	1.6	5.7
Range of counting errors (2σ)							
Maximum				34	30	0.8	0.3
Minimum				15	14	0.2	0.1

[a] Sample period and volume does not apply to this column.

the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon–222 (p.m.) concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon–222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the periods November 6–December 1, 1961, and December 4–December 29, 1961, appear in tables 1 and 2 respectively.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22,* No. 1, Feb. 1961.

Radioactivity Measurements In Surface Air

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown by figure 1. This program is operated by the U.S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile which have made the actual sample collections and forwarded them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air

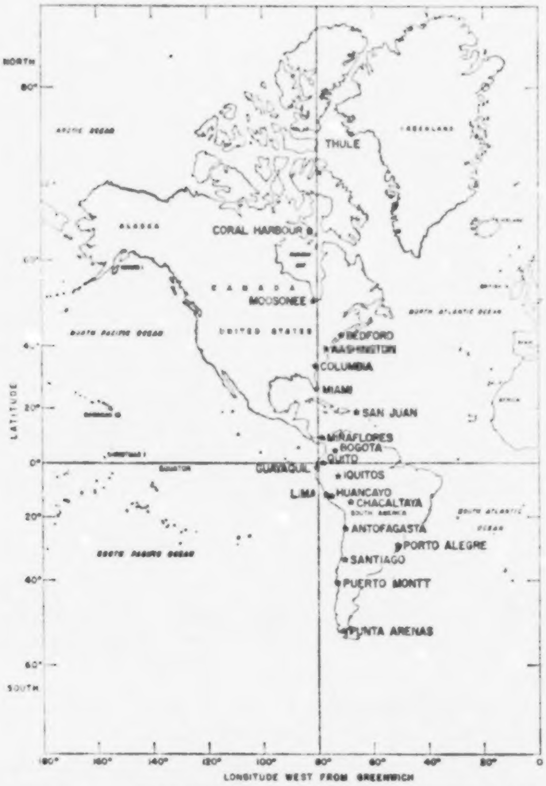
NORTH
80°
60°
40°
20°
0°
20°
40°
60°
SOUTH
LATITUDE
ARCTIC OCEAN
ALASKA
CANADA
UNITED STATES
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
SOUTH ATLANTIC OCEAN
GREENLAND
THULE
CORAL HARBOUR
MOOSONEE
BEDFORD
WASHINGTON
COLUMBIA
MIAMI
SAN JUAN
MIRAFLORES
BOGOTA
QUITO
GUAYAQUIL
IQUITOS
LIMA
HUANCAYO
CHACALTAYA
SOUTH AMERICA
ANTOFAGASTA
PORTO ALEGRE
SANTIAGO
PUERTO MONTT
PUNTA ARENAS
180°
160°
140°
120°
100°
80°
60°
40°
20°
0
LONGITUDE WEST FROM GREENWICH

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

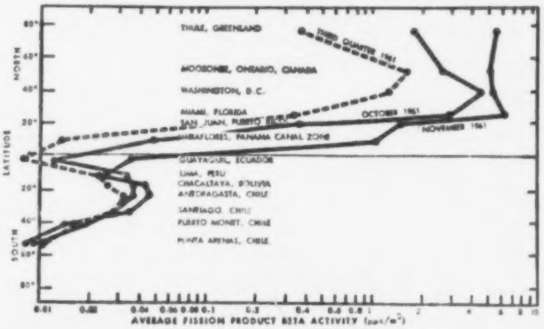

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), OCTOBER AND NOVEMBER 1961

continuously at a rate of approximately 1200 cubic meters per day through high efficiency filters 8 inches in diameter, using positive displacement blowers. Due to the decrease of radioactivity levels during 1960 and 1961, it became necessary to change the sampling period from a daily to a weekly basis at most stations. After the sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

The daily records of fission product beta activity during the months indicated are presented in tables 1 and 2; and the radioactivity profiles along the 80th Meridian (West) for the

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, OCTOBER 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland	San Juan, P. R.
1	0.02	0.04	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.4	3.54	9.30	0.16
2	0.02	0.04	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.4	1.23	9.30	0.16
3	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.71	2.44	0.16
4	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	11.3	2.44	0.16
5	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	----------	2.44	----------
6	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
7	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
8	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
9	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
10	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	6.04	2.43	0.35
11	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	8.00	2.43	0.35
12	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	6.13	2.43	0.35
13	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	1.18	2.43	0.35
14	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	4.86	2.43	0.35
15	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	9.51	2.43	0.35
16	0.03	0.05	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	5.75	2.43	0.35
17	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	5.75	2.43	1.03
18	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	2.27	3.21	1.03
19	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	3.52	3.21	1.03
20	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	3.84	3.21	1.03
21	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	6.62	3.21	1.03
22	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	8.35	3.21	1.03
23	0.02	0.04	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	10.9	3.21	1.03
24	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	11.2	3.21	1.29
25	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	11.6	4.12	1.29
26	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	6.01	4.12	1.29
27	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	1.90	4.12	1.29
28	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	2.60	4.12	1.29
29	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	4.36	4.12	1.29
30	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	4.25	4.12	1.29
31	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.50	7.48	----------	16.3	1.17
Mean (dpm/m^3)	0.019	0.043	0.063	0.081	0.079	0.074	0.027	0.108	1.267	6.61	9.40	5.92	3.82	0.788
Mean ($\mu\mu c/m^3$)	0.009	0.019	0.028	0.036	0.036	0.033	0.012	0.049	0.571	2.98	4.23	2.66	1.72	0.355

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TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NOVEMBER 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland	San Juan, P. R.
1	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	7.41	16.40	1.17
2	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	4.43	16.40	1.17
3	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	....	16.40	1.17
4	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	15.0	16.40	1.17
5	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	10.8	16.40	1.17
6	0.01	0.06	0.05	0.07	0.12	0.03	0.03	....	5.04	5.55	7.48	1.62	16.40	1.17
7	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	9.64	7.35	1.40
8	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	15.0	7.35	1.40
9	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	4.85	7.35	1.40
10	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	18.6	7.35	1.40
11	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	12.8	7.35	1.40
12	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	17.0	7.35	1.40
13	....	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	7.96	7.35	1.40
14	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	54.0	....	3.61
15	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	42.3	11.2	3.61
16	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	11.9	11.2	3.61
17	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	....	11.2	3.61
18	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	6.69	11.2	3.61
19	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	5.91	11.2	3.61
20	....	....	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	4.28	11.2	3.61
21	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	....	11.2	7.62
22	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	16.3	11.8	7.62
23	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	12.5	11.8	7.62
24	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	4.35	11.8	7.62
25	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	5.27	11.8	7.62
26	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	6.55	11.8	7.62
27	....	....	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	1.30	11.8	7.62
28	....	0.04	....	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	3.50	14.5	3.50
29	....	0.04	....	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	4.32	14.5	3.50
30	....	0.04	....	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	3.22	14.5	3.50
Mean (dpm/m^3)	0.010	0.034	0.081	0.103	0.095	0.056	0.080	2.31	7.39	13.55	11.42	11.39	11.81	3.53
Mean ($\mu\mu c/m^3$)	0.005	0.015	0.036	0.046	0.043	0.025	0.036	1.04	3.33	6.11	5.14	5.13	5.32	1.59

TABLE 3.—RADIOCHEMICAL ANALYSES OF MONTHLY COMPOSITE AIR-FILTER COLLECTIONS

Month 1960	Activity ($\mu\mu c/m^3$)[a]									
	Gross β	Ce^{141}	Sr^{89}	Y^{91}	Ce^{144}	Pm^{147}	Sr^{90}	Cs^{137}	W^{185}[b]	Pb^{210}
Thule, Greenland (Latitude 76°35′ North, Longitude 68°35′ West, Elevation 259 Meters)										
January	0.13	*[d]	*	*	0.0026	0.0089	0.00278	0.0058	0.00115	—[e]
March	0.16	*	(0.0008)[c]	*	0.0253	0.0147	0.00419	0.0060	0.00063	—
May	0.10	*	(0.0003)	*	0.0164	0.0082	0.00320	0.0064	0.00023	—
July	0.081	*	*	*	0.0123	0.0078	0.00277	0.0054	0.00019	—
September	0.032	*	*	*	0.0042	0.0025	0.00105	0.0019	—	0.0026
November	0.027	*	*	*	0.0036	0.0028	0.00099	0.0017	—	0.0100
Moosonee, Ontario, Canada (Latitude 51°16′ North, Longitude 80°39′ West, Elevation 10 Meters)										
January	0.090	*	*	*	0.0129	0.0052	0.00159	0.0035	0.00059	—
March	0.18	*	(0.0017)	*	0.0258	0.0106	0.00386	0.0076	0.00078	—
May	0.13	*	(0.0004)	*	0.0259	0.0135	0.00491	0.0089	0.00025	—
July	0.12	*	*	*	0.0204	0.0124	0.00448	0.0084	0.00017	—
September	0.054	*	*	*	0.0065	0.0048	0.00155	0.0031	—	0.0095
November	0.036	*	*	*	0.0050	0.0021	0.00080	0.0015	—	0.0123
Washington, D. C. (Latitude 38°50′ North, Longitude 76°57′ West, Elevation 88 Meters)										
January	0.11	*	(0.0006)	*	0.0177	0.0067	0.00219	0.0047	0.00080	—
March	0.19	*	(0.0019)	*	0.0283	0.0131	0.00423	0.0091	0.00071	—
May	0.22	*	(0.0006)	*	0.0387	0.0198	0.00757	0.0154	0.00045	—
July	0.15	*	*	*	0.0303	0.0203	0.00689	0.0133	0.00020	—
September	0.081	*	*	*	0.0097	0.0080	0.00245	0.0045	—	0.0216
November	0.063	*	*	*	0.0062	0.0037	0.00159	0.0033	—	0.0283
Miami, Florida (Latitude 25°49′ North Longitude 80°17′ West, Elevation 4 Meters)										
January	0.19	*	(0.0022)	*	0.0377	0.0159	0.00478	0.0059	0.00191	—
March	0.44	0.037	0.0215	0.0137	0.0455	0.0199	0.00680	0.0070	0.00104	—
May	0.24	*	(0.00009)	*	0.0405	0.0222	0.00784	0.0115	0.00046	—
July	0.059	*	*	*	0.0103	0.0068	0.00216	0.0028	0.00013	—
September	0.032	*	*	*	0.0037	0.0022	0.00080	0.0011	—	0.0036
November	0.063	*	*	*	0.0085	[illegible]	0.00228	0.0023	—	0.0071

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TABLE 3.—RADIOCHEMICAL ANALYSES OF MONTHLY COMPOSITE AIR-FILTER COLLECTIONS—Continued

Month 1960	Activity (μμc/m³)[a]									
	Gross β	Ce^{141}	Sr^{89}	Y^{91}	Ce^{144}	Pm^{147}	Sr^{90}	Cs^{137}	W^{185}[b]	Pb^{210}
Mauna Loa, Hawaii (Latitude 19°28′ North, Longitude 155°36′ West, Elevation 3394 Meters)										
January	0.15	•	•	•	0.0309	0.0128	0.00419	0.0084	0.00149	—
March	0.52	0.060	0.064	0.0283	0.0381	0.0163	0.00626	0.0114	0.00073	—
May	0.14	•	(0.0010)	•	0.0273	0.0148	0.00559	0.0105	0.00035	—
July	0.14	•	—	—	0.0256	0.0154	—	—	0.00032	—
September	0.063	•	•	•	0.0084	0.0050	0.00183	0.0036	—	0.0058
November	0.045	•	•	•	0.0062	0.0048	0.00173	0.0033	—	0.0073
Miraflores, Panama Canal Zone (Latitude 9°00′ North, Longitude 79°35′ West, Elevation 10 Meters)										
January	0.077	•	•	(0.0005)	0.0114	0.0061	0.00146	0.00191	0.00057	—
March	2.50	0.505	0.231	0.189	0.0686	0.0200	0.00387	0.00070	0.00037	—
May	0.027	•	(0.00014)	•	0.0029	0.00157	0.00062	0.00114	0.00008	—
July	0.023	•	•	•	0.0025	0.00160	0.00054	0.00086	0.00004	—
September	0.014	•	•	•	0.0047	0.00041	0.00019	0.00026	—	0.0022
November	0.014	•	•	•	0.00072	0.00053	0.00019	0.00027	—	0.0033
Guayaquil, Ecuador (Latitude 2°10′ South, Longitude 79°52′ West, Elevation 7 Meters)										
January	0.027	•	•	•	0.0035	0.0016	0.00053	0.0011	0.00020	—
March	0.21	0.082	0.0464	0.0293	0.0112	0.0034	0.00077	0.0019	0.00010	—
May	0.032	•	(0.00009)	(0.0009)	0.0018	0.0010	0.00039	0.00076	—	0.0130
July	—	—	—	—	—	—	—	—	—	—
September	0.018	•	•	•	0.0012	0.00077	0.00033	0.00072	—	0.0037
November	0.027	•	•	•	0.0035	0.0024	0.00125	0.0023	—	0.0061
Lima, Peru (Latitude 12°06′ South, Longitude 77°01′ West, Elevation 134 Meters)										
January	0.018	•	•	•	0.0028	0.00135	0.00044	0.00094	0.00019	—
March	0.023	(0.0020)	0.0010	0.00064	0.0029	0.00136	0.00052	0.00096	0.00014	—
May	0.009	•	•	•	0.00058	(0.00049)	0.00014	0.00025	—	0.0033
July	0.018	—	—	—	—	—	—	—	—	—
September	0.027	•	•	•	0.0035	0.0023	0.00097	0.00169	—	0.0017
November	0.023	•	•	•	0.0029	0.0022	0.00091	0.00167	—	0.0033
Chacaltaya, Bolivia (Latitude 17°10′ South, Longitude 68°15′ West, Elevation 5220 Meters)										
January	0.014	•	•	•	0.0010	0.0058	0.00018	0.00061[b]	0.00055	—
March	0.045	(0.0017)	(0.0008)	•	0.0031	0.00187	0.00059	0.00115	0.00018	—
May	0.041	•	•	•	0.0026	0.00147	0.00067	0.00100	—	0.0083
July	0.041	—	—	—	—	—	—	—	—	—
September	0.041	•	•	•	0.0034	0.0023	0.00091	0.00176	—	0.0117
November	0.041	•	•	•	0.0027	0.0021	0.00084	0.00172	—	0.0107
Antofagasta, Chile (Latitude 23°37′ South, Longitude 70°16′ West, Elevation 519 Meters)										
January	0.045	•	•	•	0.0066	0.0030	0.00100	0.0024[b]	0.00047	—
March	0.058	•	(0.0009)	(0.0005)	0.0070	0.0035	0.00137	0.0029	0.00027	—
May	0.032	•	•	•	0.0036	0.0021	0.00080	0.0015	—	0.0132
July	0.045	•	•	•	0.0061	0.0036	0.00164	0.0030	—	0.0061
September	0.063	•	•	•	0.0084	0.0055	0.00234	0.0029	—	0.0014
November	0.050	•	•	•	0.0068	0.0050	0.00205	0.0040	—	0.0051
Santiago, Chile (Latitude 33°27′ South, Longitude 70°42′ West, Elevation 520 Meters)										
January	0.054	•	•	•	0.0077	0.0042	0.00129	0.0026	0.00053	—
March	0.063	•	•	•	0.0078	0.0041	0.00162	0.0024	0.00034	—
May	0.036	•	•	•	0.0031	0.0018	0.00068	0.0013	—	0.0128
July	0.036	•	•	•	0.0044	0.0027	0.00114	0.0016	—	0.0075
September	0.059	•	•	•	0.0074	0.0046	0.00211	0.0042	—	0.0044
November	0.050	•	•	•	0.0076	0.0054	0.00238	0.0048	—	0.0060
Puerto Montt, Chile (Latitude 41°27′ South, Longitude 72°57′ West, Elevation 5 Meters)										
January	0.041	•	•	•	0.0074	0.0038	0.00128	0.0020	0.00068	—
March	0.045	•	•	•	0.0068	0.0034	0.00140	0.0024	0.00022	—
May	0.023	•	•	•	0.0037	0.0021	0.00079	0.00130	—	0.0029
July	0.009	•	•	•	0.0016	0.0010	0.00041	0.00072	—	0.0012
September	0.023	•	•	•	0.0031	0.0018	0.00100	0.00127	—	0.0013
November	—	—	—	—	—	—	—	—	—	—
Punta Arenas, Chile (Latitude 53°08′ South, Longitude 70°53′ West, Elevation 3 Meters)										
January	0.[illegible]	•	•	•	0.0028	0.0016	0.00060	0.00114	0.00027	—
March	0.018	•	•	•	0.0035	0.0018	0.00073	0.00120	0.00023	—
May	0.023	•	•	•	0.0028	0.0019	0.00066	0.00135	—	0.0020
July	0.009	•	•	•	0.0014	0.0010	0.00036	0.00067	—	0.0007
September	0.014	•	•	•	0.0024	0.0016	0.00071	0.00132	—	0.0017
November	0.009	•	•	•	0.0013	0.0012	0.00045	(0.0010)	—	0.0006

[a] Counting error <1% (σ) unless otherwise indicated.
[b] Counting error in range of 1-5% (σ).
[c] ( ) indicates counting error >5% (σ).
[d] • indicates activity too low for measurement.
[e] — indicates no analytical results reported.

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same months are shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air.

A summary of the radiochemical analyses of monthly composite air-filter collections made during 1960 is presented in table 3 in $\mu\mu c/m^3$ of standard air.[1] All activities (except gross beta) are corrected for decay to the midpoint of the month listed. Unless otherwise indicated, the counting errors were less than ± 1 percent at the 68.3 percent confidence level (σ).

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[1] Lockhart, Jr., L. B., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black, "Fission Product Radioactivity in the Air Along the 80th Meridian (West) During 1960," *NRL Report 5692*, October 24, 1961.

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SECTION II.—FOOD, OTHER THAN MILK

Tri-City Diet Study[1]

Joseph Rivera
Health and Safety Laboratory, U.S. Atomic Energy Commission

Approximately every three months since May 1960, estimates of the strontium-90 content of average diets for individuals living in New York City, San Francisco, and Chicago have been made by the Health and Safety Laboratory. Results obtained from analyses of foods purchased in the first four samplings have been reported in *Quarterly Summary Reports, HASL-105, 111, 113, and 115* and presented in the April, June, October, and December 1961 *Radiological Health Data.*

Selected foods, representing 19 food categories, are purchased at each of these three cities about every three months and are analyzed for strontium-90 and stable calcium. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium-90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document. Further details of the food purchase plan for this study were presented in *HASL-90.*

Results obtained from the fifth sampling of foods are presented in table 1. Table 2 presents a summary of the annual intake of strontium-90 from all five samplings. The data in these tables show no significant changes in the relative contributions of the various foods to the total intake, or in the total intake of strontium-90 since the fourth sampling. Contributions of strontium-90 from tap water are not included in these tables, but measurements during 1960 and 1961 indicate the contribution would be in the range of 100 to 200 μμc Sr^{90} per year. It is assumed in making this estimate that the average daily intake of tap water is 1.2 liters.

Using the totals given in table 1, the following average concentrations in μμc Sr^{90}/gm Ca may be calculated for the annual intake: New York, 11.0; Chicago, 5.7; San Francisco, 2.9. This calculation was based on calcium data obtained from the first two sampling periods. Despite the fact that there is some variability in the results obtained from analyses of individual food categories, the total intake of calcium was calculated to be 383 grams per person with a standard deviation of less than 5 percent. Because of the relative constancy of the average annual intake of calcium due to its strong dependence on the relatively constant calcium content of milk, analyses of food categories, other than milk, for calcium were discontinued after the second sampling.

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[1] Data from *Quarterly Summary Report, HASL-117,* December 30, 1961.

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TABLE 1.—STRONTIUM-90 LEVELS OF DIET—FIFTH SAMPLING

Food type	Annual consumption	New York City May 1961		Chicago July 1961		San Francisco June 1961	
	(kg/yr)	μμc/kg	μμc/yr	μμc/kg	μμc/yr	μμc/kg	μμc/yr
Whole grain products	11	7.8	86	7.9	87	5.1	56
Refined grain products	37	10.3	381	6.2	229	2.1	79
Refined grain flour	43	5.4	232	6.0	258	2.8	120
Milk, liquid	221	8.9	1967	4.5	995	1.9	420
Potatoes	45	1.4	63	0.9	41	1.3	57
Macaroni	3	3.5	11	3.7	11	3.0	9
Beans, dried	3	16.7	50	15.2	46	7.6	23
Vegetables, canned	20	3.1	62	4.0	80	1.7	33
Vegetables, fresh	43	11.4	490	2.4	103	1.1	47
Vegetables, root	17	25.2	428	3.1	53	2.7	46
Fruit, canned	26	1.0	26	0.9	23	1.3	33
Fruit juices	19	2.3	44	2.2	42	1.6	30
Fruit, fresh	68	4.1	279	0.7	48	1.2	81
Rice	3	1.2	4	1.4	4	1.1	3
Eggs	16	1.7	27	2.2	35	1.4	22
Fish, fresh	8	0.6	5	0.4	3	0.7	6
Fish, sheil	1	0.8	1	0.5	1	2.7	3
Meat	73	0.6	44	0.8	58	0.6	45
Poultry	17	0.8	14	3.8	65	0.8	13
Total annual intake			4214		2182		1129

TABLE 2.—SUMMARY OF STRONTIUM-90 ANNUAL INTAKE

[μμc/year]

Food type	San Francisco					Chicago					New York City				
	March 1960	Aug 1960	Jan 1961	Mar 1961	June 1961	May 1960	Sept 1960	Nov 1960	April 1961	July 1961	March 1960	June 1960	Oct 1960	Feb 1961	May 1961
Whole grain products	32	121	16	138	56	219	180	168	183	87	228	310	187	70	86
Refined grain products	95	167	144	242	79	485	337	185	358	229	352	377	211	322	381
Refined grain flour	156	172	86	23	120	486	340	237	351	258	447	397	215	251	232
Milk, liquid	928	420	398	464	420	1348	2138	1392	1164	995	2100	2431	1370	1735	1967
Potatoes	198	27	166	126	57	131	126	58	189	41	441	144	248	207	63
Macaroni	11	12	9	10	9	29	23	15	12	11	22	14	21	11	11
Beans, dried	19	11	13	4	23	5	22	48	61	46	6	7	25	58	50
Vegetables, canned	37	16	24	16	33	94	108	116	132	80	84	58	106	50	62
Vegetables, fresh	98	129	86	103	47	474	237	271	416	103	237	585	757	151	490
Vegetables, root	98	12	48	61	46	116	58	51	155	53	90	88	82	75	428
Fruit, canned	37	49	91	25	33	49	23	29	29	23	39	47	34	58	26
Fruit, juices	45	38	49	38	30	67	38	57	66	42	29	57	61	43	44
Fruit, fresh	46	68	122	157	81	408	109	279	ᵃ279	48	20	129	557	442	279
Rice	5	6	5	5	3	5	4	3	6	4	7	3	7	0	4
Eggs	47	37	37	33	22	51	30	22	26	35	170	32	51	21	27
Fish, fresh	2	2	2	2	6	8	1	21	28	3	2	2	1	5	5
Fish, shell	1	1	1	4	3	1	1	1	4	1	2	1	1	1	1
Meat	139	37	44	21	45	73	73	44	23	58	73	66	66	47	44
Poultry	13	24	36	11	13	22	43	15	11	65	27	12	14	6	14
Total annual intake	2007	1349	1378	1482	1129	4074	2991	3012	3493	2182	4376	4760	3992	3533	4214

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[a] Estimated from November 1960 sampling.

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *Radiological Health Data* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

Surveillance of pasteurized milk is currently conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies, who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 31 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication of data follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During the second week in September, when increased levels of gross beta radioactivity in air were reported by the Radiation Surveillance Network, the frequency of milk sampling was accelerated at selected stations. Daily sam-

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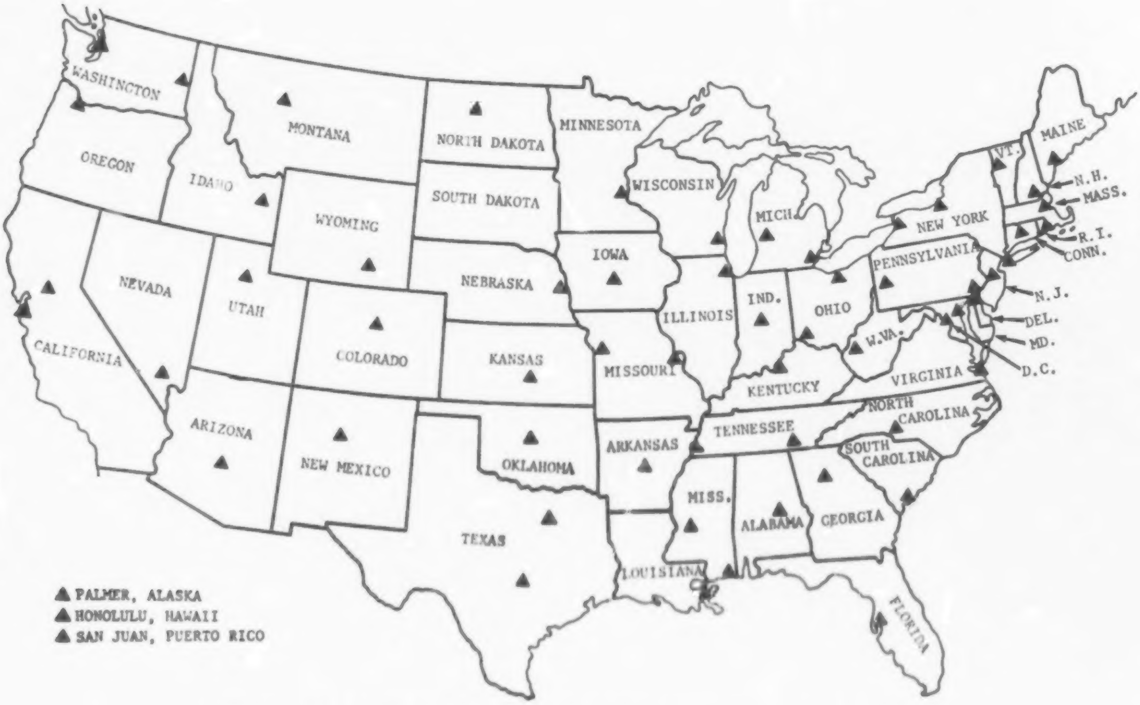
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICH.
IND.
OHIO
KENTUCKY
TENNESSEE
MISS.
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W.VA.
PENNSYLVANIA
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
D.C.
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS

pling of pasteurized milk, with analyses for iodine-131 content, was initiated on September 19, 1961, at six selected stations.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The cesium-137 and barium-140 data were determined on most of the milk samples obtained for iodine-131 analyses by the Southwestern Radiological Health Laboratory. The minimum level of detection for strontium-89 is 5 µµc/liter, and for barium-140 and iodine-131, 10 µµc/liter.

Table 1 presents a summary of all available analyses. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the average for the month. When a radionuclide was not detectable, one-half the minimum level of detection was used for averaging.

The sampling schedule in effect during most of October 1961 was presented in the January 1962 *Radiological Health Data.* With the conclusion of the Soviet Union's 1961 series of atmospheric tests, the iodine-131 levels are more predictable and it becomes necessary for the analytical program to shift to other radionuclides. This need is emphasized by the fact that the analytical procedures become more difficult as the levels of activity become lower and the longer lived nuclides increase in relative importance. Therefore, beginning in December 1961, the following sampling schedule became effective:

1. Six daily sampling stations (St. Louis, Seattle, New York, Chicago, Boston, and New Orleans) to be maintained so that the pattern of normal decline in iodine-131 content of milk at these points may be carefully studied.
2. Any station in the program, not included in the daily sampling schedule where the iodine-131 level exceeds 100 µµc/liter at the time of sampling, to be placed on a two samples per week schedule until this concentration drops and remains below 100 for two consecutive weeks.
3. All other sampling stations to be placed on a weekly sampling schedule.
4. A full analysis to be completed on a weekly

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, OCTOBER 1961

[Average concentrations in $\mu\mu c$/liter]

Area		Calcium (grams/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average
Montgomery	Ala.	[c] NA	1.20 (1)	NA	15 (1)	NA	7 (1)	NA	30 (1)	NA	<5 (1)	NA	10 (1)
Palmer	Alaska	1.12	[a]1.11 (3)	[b]—	105 (4)	7	16 (4)	—	330 (9)	10	15 (6)	—	100 (6)
Phoenix	Ariz.	1.04	1.03 (1)	—	<5 (1)	4	3 (1)	—	60 (3)	<5	10 (3)	—	<10 (3)
Little Rock	Ark	1.21	1.16 (2)	—	35 (2)	16	15 (2)	—	120 (2)	10	30 (1)	—	30 (2)
Sacramento	Calif.	1.10	1.11 (4)	<5	10 (5)	5	8 (5)	<10	20 (15)	10	10 (12)	<10	<10 (15)
San Francisco	Calif.	1.06	1.13 (1)	—	<5 (1)	4	3 (1)	—	20 (2)	10	10 (2)	—	10 (2)
Denver	Colo.	1.05	1.08 (4)	<5	15 (4)	5	6 (4)	20	90 (17)	10	15 (16)	<10	20 (16)
Hartford	Conn.	1.15	1.18 (2)	—	30 (2)	8	10 (2)	—	60 (3)	15	10 (1)	—	50 (2)
Wilmington	Del.	1.18	1.17 (2)	—	45 (2)	10	15 (2)	—	60 (3)	15	<5 (1)	—	30 (2)
Washington	D. C.	1.14	1.16 (5)	5	35 (5)	7	8 (5)	20	60 (25)	10	5 (1)	<10	30 (5)
Tampa	Fla.	1.24	1.23 (3)	<5	15 (3)	5	5 (3)	20	40 (10)	85	75 (1)	<10	30 (3)
Atlanta	Ga.	1.23	1.20 (4)	<5	20 (4)	10	12 (4)	30	80 (22)	15	NA	<10	30 (4)
Honolulu	Hawaii	1.06	1.04 (1)	—	<5 (1)	6	4 (1)	—	20 (3)	10	20 (3)	—	10 (3)
Idaho Falls	Idaho	1.05	1.11 (1)	—	35 (1)	6	8 (1)	—	140 (3)	5	15 (3)	—	20 (3)
Chicago	Ill.	1.14	1.18 (4)	10	55 (4)	5	9 (4)	40	150 (22)	15	NA	<10	60 (4)
Indianapolis	Ind.	1.18	1.22 (2)	—	30 (2)	6	7 (2)	—	70 (2)	10	<5 (1)	—	10 (2)
Des Moines	Iowa	1.04	1.08 (1)	—	65 (1)	7	15 (1)	—	290 (3)	10	15 (3)	—	40 (3)
Wichita	Kans.	1.08	1.08 (4)	—	30 (4)	11	11 (4)	—	130 (22)	5	15 (18)	—	20 (18)
Louisville	Ky.	1.15	1.18 (2)	—	15 (2)	9	11 (2)	—	90 (3)	5	<5 (1)	—	20 (2)
New Orleans	La.	1.28	1.27 (5)	5	40 (5)	13	15 (5)	30	80 (22)	25	15 (1)	<10	30 (5)
Portland	Maine	1.19	1.22 (1)	10	120 (1)	9	11 (1)	10	120 (2)	30	10 (1)	<10	70 (1)
Baltimore	Md.	1.16	1.16 (2)	—	30 (2)	10	8 (2)	—	70 (2)	15	<5 (1)	—	20 (2)
Boston	Mass.	1.17	1.18 (2)	—	120 (2)	10	12 (2)	—	130 (3)	30	20 (1)	—	60 (2)
Detroit	Mich.	1.14	1.18 (2)	—	50 (2)	6	7 (2)	—	210 (2)	5	<5 (1)	—	50 (2)
Grand Rapids	Mich.	1.18	1.18 (2)	—	75 (2)	7	7 (2)	—	90 (2)	5	<5 (1)	—	40 (2)
Minneapolis	Minn.	1.07	1.04 (1)	—	170 (1)	9	17 (1)	—	340 (2)	15	25 (2)	—	90 (2)
Jackson	Miss.	1.26	1.28 (1)	5	40 (5)	12	12 (5)	50	90 (21)	15	10 (1)	<10	30 (5)
Pascagoula	Miss.	[c] NA	1.27 (5)	NA	30 (5)	NA	14 (5)	70	100 (22)	NA	<5 (1)	NA	40 (5)
Kansas City	Mo.	1.04	1.07 (6)	—	85 (1)	9	7 (1)	—	150 (5)	5	15 (2)	—	20 (2)
St. Louis	Mo.	1.07	1.07 (7)	10	30 (6)	8	10 (6)	60	160 (25)	10	15 (18)	<10	20 (18)
Helena	Mont.	1.05	1.13 (1)	—	15 (1)	7	13 (1)	—	160 (2)	15	25 (2)	—	20 (2)
Omaha	Nebr.	1.13	1.06 (4)	—	125 (4)	8	15 (4)	—	250 (19)	10	15 (14)	—	80 (14)
Manchester	N. H.	1.19	1.21 (2)	—	40 (2)	9	12 (2)	—	100 (3)	40	30 (1)	—	60 (2)
Trenton	N. J.	1.14	1.21 (2)	—	40 (2)	8	8 (2)	—	90 (2)	10	<5 (1)	—	20 (2)
Albuquerque	N. Mex.	1.09	1.02 (1)	—	<5 (1)	3	10 (1)	—	30 (2)	5	10 (2)	—	<10 (2)
Buffalo	N. Y.	1.13	1.12 (2)	—	45 (2)	7	11 (2)	—	100 (3)	10	<5 (1)	—	30 (2)
New York	N. Y.	1.13	1.13 (5)	5	50 (5)	9	8 (5)	50	100 (25)	15	<5 (1)	10	40 (5)
Syracuse	N. Y.	1.15	1.17 (2)	—	90 (2)	6	8 (2)	—	140 (3)	10	10 (1)	—	70 (2)
Charlotte	N. C.	1.22	1.26 (2)	—	30 (2)	12	9 (2)	—	40 (3)	10	<5 (1)	—	10 (2)
Minot	N. D.	1.04	1.08 (1)	5	40 (1)	7	12 (1)	20	140 (1)	10	15 (1)	<10	<10 (1)
Cincinnati	Ohio	1.20	1.22 (2)	—	25 (2)	9	6 (2)	—	100 (2)	<5	<5 (1)	—	30 (2)
Cleveland	Ohio	1.17	1.20 (2)	—	40 (2)	7	7 (2)	—	100 (2)	5	<5 (1)	—	30 (2)
Oklahoma City	Okla.	1.19	1.14 (2)	—	30 (2)	6	6 (2)	—	90 (2)	5	20 (1)	—	10 (2)
Portland	Oreg.	1.10	1.11 (1)	—	<5 (1)	11	12 (1)	—	60 (2)	20	25 (2)	—	10 (2)
Philadelphia	Pa.	1.18	1.22 (2)	—	35 (2)	8	7 (2)	—	80 (2)	15	<5 (1)	—	<10 (2)
Pittsburgh	Pa.	1.15	1.16 (2)	—	65 (2)	11	9 (2)	—	90 (3)	10	<5 (1)	—	40 (2)
San Juan	P. R.	1.17	1.22 (2)	—	10 (2)	4	7 (2)	—	20 (2)	10	<5 (1)	—	20 (2)
Providence	R. I.	1.15	1.18 (2)	—	60 (2)	12	10 (2)	—	80 (3)	30	15 (1)	—	40 (2)
Charleston	S. C.	1.22	1.23 (5)	<5	15 (5)	11	11 (5)	30	60 (23)	30	15 (1)	<10	20 (5)
Chattanooga	Tenn.	1.28	1.22 (1)	—	25 (1)	12	10 (1)	—	80 (2)	15	10 (1)	—	<10 (1)
Memphis	Tenn.	1.23	1.24 (2)	—	30 (2)	12	7 (2)	—	160 (2)	5	<5 (1)	—	10 (2)
Austin	Tex.	1.20	1.17 (4)	<5	10 (4)	2	4 (4)	10	30 (31)	<5	NA	<10	<20 (4)
Dallas	Tex.	1.17	1.23 (1)	<5	20 (1)	6	8 (1)	10	40 (1)	10	NA	<10	20 (1)
Salt Lake City	Utah	1.16	1.11 (5)	5	25 (4)	4	7 (4)	50	120 (22)	10	15 (17)	<10	20 (17)
Burlington	Vt.	1.14	1.18 (2)	—	50 (2)	8	8 (2)	—	100 (3)	15	20 (1)	—	50 (2)
Norfolk	Va.	1.22	1.24 (2)	—	85 (2)	9	8 (2)	—	80 (3)	10	<5 (1)	—	30 (3)
Seattle	Wash.	1.06	1.10 (5)	10	75 (6)	11	15 (6)	<10	120 (25)	15	30 (20)	<10	50 (20)
Spokane	Wash.	1.04	1.18 (1)	—	10 (1)	9	6 (1)	—	120 (3)	20	25 (3)	—	10 (3)
Charleston	W. Va.	1.17	1.17 (2)	—	70 (2)	11	8 (2)	—	60 (3)	10	<5 (1)	—	30 (2)
Milwaukee	Wis.	1.17	1.17 (5)	—	40 (5)	5	9 (5)	—	150 (31)	10	10 (1)	—	40 (5)
Laramie	Wyo.	1.04	1.08 (1)	—	<5 (1)	7	8 (1)	—	40 (3)	15	20 (3)	—	20 (3)
Network average[d]		1.14	1.16	5	40	8	9	30	100	15	15	<10	30

[a] Number in parentheses indicates total number of analyses reported during October.

[b] Dash indicates that the average concentration during the third quarter was reported to be less than the level of detection. The minimum level of detection for Sr^{89} is 5 $\mu\mu c$/liter, and for Ba^{140} and I^{131}, 10 $\mu\mu c$/liter. The samples were collected prior to the effect of Russian nuclear weapons testing.

[c] NA indicates no analysis made.

[d] Stations with dashes not included in network averages.

basis for all samples (stable calcium, strontium-89, strontium-90, cesium-137, barium-140, and iodine-131). For those stations where samples are collected more often than once a week, the laboratories will composite for the weekly analytical schedule as above, except for those radionuclides immediately determined by gamma scan on each sample as received.

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing would, of course, require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Comparison of the results of the October

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averages with the third quarter averages shows that the October stable calcium, strontium-90, and cesium-137 results are generally within anticipated variations. The analyses for strontium-89 and barium-140 show that the concentrations of these nuclides are increasing in pasteurized milk. The October iodine-131 levels show an increase over the previous month. The daily iodine-131 results for September and October were published in the November and December 1961 *Radiological Health Data*, respectively. The November daily results, published in the January 1962 issue show that the iodine-131 levels are declining.

Iodine-131 in Bovine Milk From Minnesota

Division of Environmental Sanitation
Minnesota Department of Health

The Minnesota State Department of Health, Division of Environmental Sanitation, initiated a small bovine milk surveillance network in September 1958. Analyses for strontium-90 were made on the samples from these network stations. These strontium-90 data have been published in the July and December 1960, and the June and October 1961 *Radiological Health Data*.

In October 1961, following the resumption of atmospheric weapons testing by the U.S.S.R., a special network of stations, shown in figure 1, was established for the collection of "grab" milk samples at milk processing plants. These samples were analyzed for radioiodine concentrations. The data are reported in table 1.

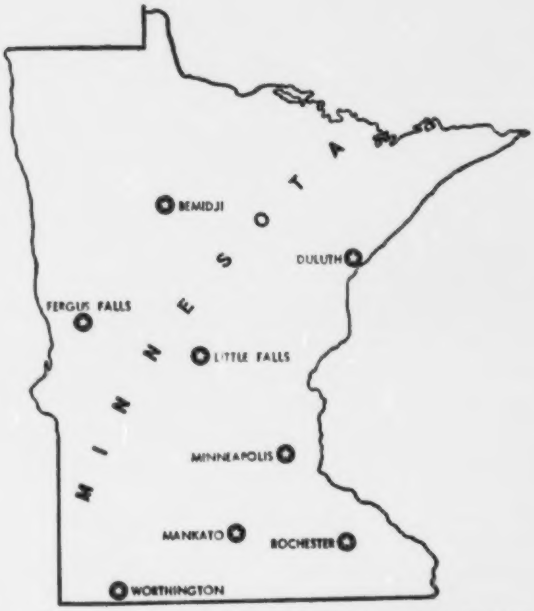

FIGURE 1.—MINNESOTA SAMPLING LOCATIONS FOR IODINE-131 IN BOVINE MILK

TABLE 1.—IODINE-131 LEVELS IN BOVINE MILK FROM MINNESOTA, OCTOBER-DECEMBER 1961

[Concentrations in μμc/liter]

Samples collected the week of	Bemidji	Duluth	Fergus Falls	Little Falls	Mankato	Minneapolis	Rochester	Worthington (vicinity)
October 16	130	170	40	240	130	200	100	80
30	370	440	130	290	60	280	300	220
November 13	70	160	30	40	140	130	50	120
20	60	40	<15	<15	30	110	40	120
27	20	<15	20	<15	<15	<15	<15	60
December 4	[a] <15	<15	<15	<15	<15	40	<15	70
11	<15	<15	<15	<15	<15	<15	<15	<15
18	<15	<15	<15	<15	<15	<15	<15	<15

[a] Lower limit of detection.

Radioactivity in Milk

Health and Safety Laboratory
U.S. Atomic Energy Commission

In 1954, the Health and Safety Laboratory began monitoring milk in New York City for strontium-90 in order to estimate the potential hazard resulting from the contamination of foods by fallout. Subsequently, monitoring was initiated at Mandan, North Dakota; Perry, New York; and Honolulu, Hawaii.

Prior to July 1960, strontium-89, strontium-90, and calcium were reported. Because of the low strontium-89 levels since July 1960, analyses for this nuclide were discontinued but were resumed again for July 1961 samplings. Strontium-89 was found to be still below the levels of detection. Table 1 presents the 1959 and 1960 averages as well as the May, June, and July 1961 data.[1] Data on strontium-90 in liquid and powdered milk for this period are presented graphically in figures 1 and 2.

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[1] Data from *Quarterly Summary Report, HASL-117,* December 30, 1961.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN MILK SAMPLES, MAY-JULY 1961

Sampling station and period	Strontium-90			Calcium	
	μμc/liter	μμc/kg	μμc/gm Ca	gm/liter	gm/kg
Perry, New York (powdered milk)					
1959 average			8.0		
1960 average			6.5		
May 1961		71	6.6		10.7
June 1961		59	5.9		9.9
July 1961		62	6.3		9.9
New York, New York (liquid milk)					
1959 average			11.0		
1960 average			8.0		
May 1961	8.9		8.1	1.10	
June 1961	9.6		8.4	1.14	
July 1961	8.6		7.0	1.23	
Mandan, North Dakota (powdered buttermilk)					
1959 average			25.7		
1960 average			15.0		
May 1961		125	12.0		10.4
June 1961		116	9.6		12.1
July 1961		78	7.3		10.7
Honolulu, Hawaii[1] (liquid milk)					
1959 average			5.0		
1960 average			3.2		
May 1961	2.2 1.8		2.1 1.9	1.02 0.96	
June 1961	1.6 2.6		1.6 2.6	0.96 0.98	
July 1961	1.9 3.0		1.5 2.2	1.27 1.38	

[1] Two results per month represents milk from two dairies.

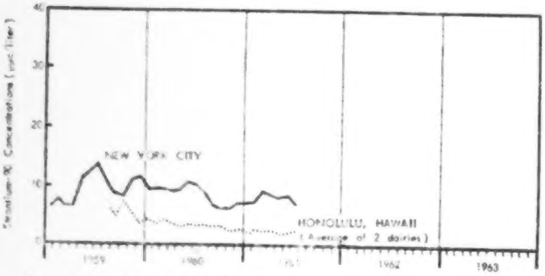

FIGURE 1.—STRONTIUM-90 IN LIQUID MILK SAMPLES, JANUARY 1959-JULY 1961

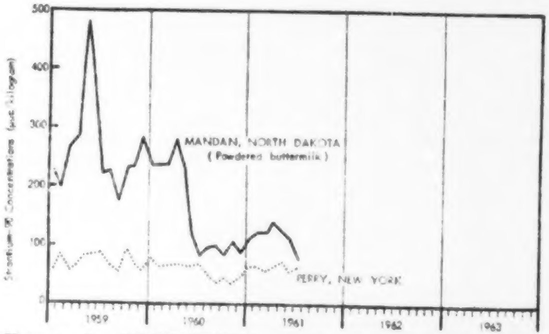

FIGURE 2.—STRONTIUM-90 IN POWDERED MILK SAMPLES, JANUARY 1959-JULY 1961

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SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provision of Section 4(c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies, and industrial organizations commenced operations in October 1957. As of December 1, 1961, there were 97 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in raw surface samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the USSR has resulted in an increase in radioactivity of surface waters. Evidence obtained during October–December 1961 indicates a 5- to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, Northeastern, and Eastern United States. The greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample.

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Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each had one gross alpha determination per month.

The following changes were instituted on September 1, 1961, after the resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease).
2. Beginning with samples collected October 1, 1961, strontium-90 determinations are to be made on a three months composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all information available for the period indicated. Reported strontium-90 data are the results of determinations on three-month composite samples for a quarter ending in the month shown. The data were determined on analytical schedules in effect till September 1, 1961.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957-58, 1958-59, 1959-60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," J. AWWA *51*, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," J. AWWA *52*, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," J. *AWWA*, *53*, 704 (1961).

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	September 1961					
	Strontium-90	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	0	10	10	<1	<1	1
Animas River: Cedar Hill, N. Mex	0.3	11	13	24	4	4	8
Apalachiocola River: Chattahoochie, Fla	0.4	5	3	8	0	0	0
Arkansas River:							
Coolidge, Kans	2.3	34	41	75	0	6	6
Ponca City, Okla	[a] —	18	20	38	5	8	13
Pendleton Ferry, Ark	—	165	7	172	—	—	—
Big Sioux River: Sioux Falls, S. Dak	0.4	14	31	45	0	3	3
Chattahoochie River:							
Atlanta, Ga	—	0	2	2	0	0	0
Columbus, Ga	—	<1	2	2	0	0	0
Colorado River:							
Loma, Colo	—	188	42	230	48	2	50
Page, Ariz	—	1411	46	1457	276	11	287
Boulder City, Nev	1.0	4	28	32	0	7	7
Parker Dam, Calif	—	1	19	20	1	5	6
Yuma, Ariz	—	14	29	43	2	2	4

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

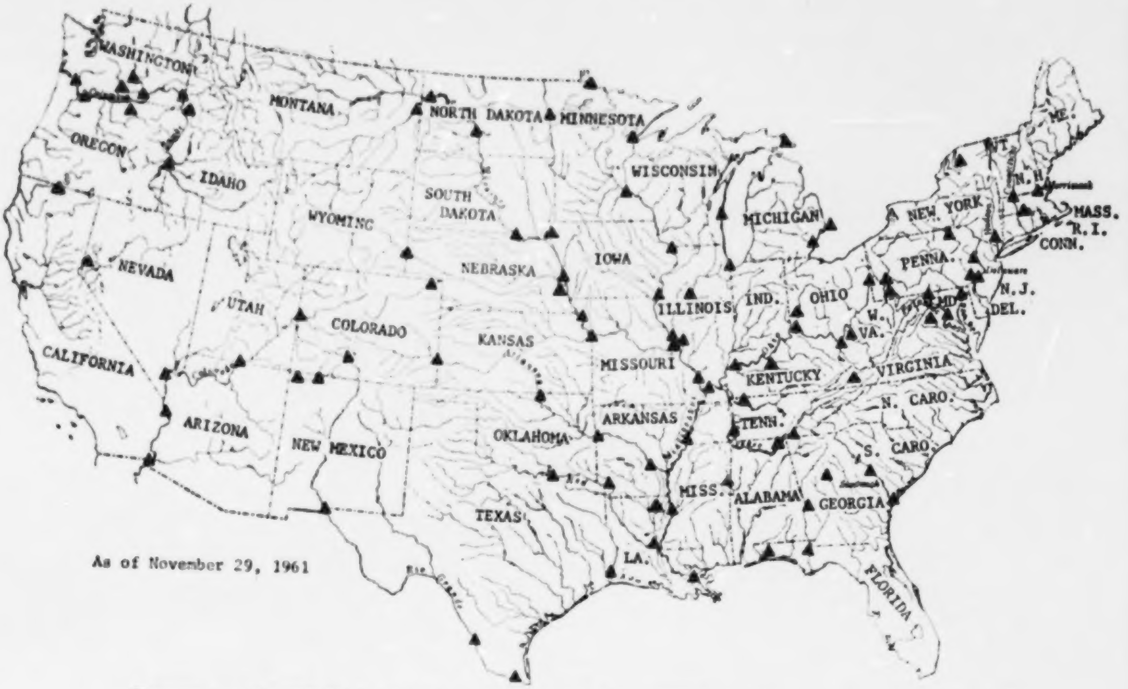
[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	September 1961					
	Strontium-90	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Columbia River:							
Wenatchee, Wash	—	1	2	3	0	0	0
Pasco, Wash	1.1	46	390	436	0	0	0
Bonneville Dam, Oreg	[b] 0.6	12	143	155	0	0	0
Clatskanie, Oreg	—	10	82	92	0	0	0
McNary Dam, Oreg	1.2	16	114	130	0	<1	<1
Connecticut River: Northfield, Mass	0.4	2	6	8	0	0	0
Cumberland River: Clarksville, Tenn	0.4	6	9	15	0	1	1
Delaware River:							
Martins Creek, Pa	—	8	2	10	0	0	0
Philadelphia, Pa	—	1	3	4	—	—	—
Escambia River: Century, Fla	[b] 0.9	—	—	—	—	—	—
Great Lakes:							
Buffalo, N. Y	—	2	5	7	0	0	0
Detroit, Mich	[b] 0.6	2	14	16	0	0	0
Port Huron, Mich	0.4	4	3	7	0	0	0
Milwaukee, Wis	—	1	2	3	0	0	0
Sault St. Marie, Mich	—	<1	<1	1	0	0	0
Gary, Ind	0.2	0	0	0	0	0	0
Duluth, Minn	—	<1	5	5	0	0	0
Hudson River: Poughkeepsie, N. Y	0.2	6	4	10	—	—	—
Illinois River: Peoria, Ill	0.4	0	8	8	0	0	0
Kanawha River: Winfield Dam, W. Va	—	4	6	10	0	0	0
Klamath River: Copco, Oreg	—	2	5	7	0	0	0
Little Miami River: Cincinnati, Ohio	1.1	1	6	7	<1	1	1
Merrimack River: Lowell, Mass	[b] 0.7	0	11	11	—	—	—
Mississippi River:							
Minneapolis, Minn	0.9	2	10	12	0	1	1
Dubuque, Iowa	—	2	14	16	0	1	1
Burlington, Iowa	0.6	6	8	14	0	0	0
E. St. Louis, Ill	—	45	17	62	—	—	—
Cape Girardeau, Mo	0.8	22	6	28	3	3	6
West Memphis, Ark	—	6	9	15	2	1	3
Delta, La	[b] 0.4	10	18	28	5	2	7
New Orleans, La	—	—	—	—	—	—	—
Missouri River:							
Williston, N. Dak	—	34	13	47	—	—	—
Bismarck, N. Dak	—	4	13	17	0	5	5
Yankton, S. Dak	0.6	6	21	27	0	2	2
Omaha, Nebr	—	28	28	56	4	6	10
St. Joseph, Mo	—	75	22	97	16	5	21
Kansas City, Kans	—	61	30	91	6	0	6
St. Louis, Mo	1.4	46	18	64	21	1	22
Monongahela River: Pittsburgh, Pa	0.4	1	8	9	0	0	0
North Platte River: Henry, Nebr	—	10	32	42	1	24	25
Ohio River:							
East Liverpool, Ohio	0.4	<1	4	4	—	—	—
Huntington, W. Va	—	<1	8	8	0	0	0
Cincinnati, Ohio	—	1	9	10	0	<1	<1
Louisville, Ky	0.4	8	7	15	0	<1	<1
Cairo, Ill	1.1	—	—	—	—	—	—
Evansville, Ind	—	0	8	8	0	<1	<1
Potomac River:							
Williamsport, Md	—	3	8	11	0	0	0
Great Falls, Md	—	2	4	6	—	—	—
Platte River: Plattsmouth, Nebr	—	105	16	121	29	2	31
Rainy River: Baudette, Minn	—	14	32	46	0	0	0
Red River, North: Grand Forks, N. Dak	—	5	10	15	—	—	—
Red River, South:							
Index, Ark	—	21	6	27	2	2	4
Denison, Tex	—	8	19	27	0	0	0
Alexandria, La	1.0	6	17	23	—	—	—
Rio Grande River:							
Alamosa, Colo	[b] 0.4	2	12	14	0	3	3
El Paso, Tex	—	5	5	10	—	—	—
Laredo, Tex	—	11	5	16	5	2	7
Brownsville, Tex	—	1	8	9	0	3	3
Roanoke River: John H. Kerr Reservoir and Dam, Va	—	1	2	3	<1	0	<1
Sabine River: Ruliff, Tex	—	1	4	5	0	0	0
San Juan River: Shiprock, N. Mex	—	94	18	112	18	2	20
St. Lawrence River: Massena, N. Y	—	<1	4	4	0	0	0
Schuylkill River: Philadelphia, Pa	—	5	6	11	—	—	—
Savannah River:							
Port Wentworth, Ga	0.4	10	8	18	—	—	—
North Augusta, S. C	—	2	4	6	0	0	0
Shenandoah River: Berryville, Va	—	4	10	14	<1	<1	1
Snake River: Wawawai, Wash	0.3	1	7	8	0	3	3
South Platte River: Julesburg, Colo	0.7	16	73	89	2	36	38
Susquehanna River:							
Sayre, Pa	0.3	10	2	12	—	—	—
Conowingo, Md	0.3	1	4	5	—	—	—
Tennessee River:							
Chattanooga, Tenn	0.6	1	16	17	0	1	1
Bridgeport, Ala	0.7	2	41	43	0	1	1
Truckee River: Farad, Calif	—	0	0	0	0	0	0
Yakima River: Richland, Wash	0.4	2	11	13	0	2	2
Yellowstone River: Sidney, Mont	—	420	25	445	124	3	127

[a] Dash denotes no sample received or no determinations made.

[b] April–September 1961.

Correction for February issue: The August 1961 water data, which appeared in the February 1962 issue of *RHD*, was inadvertently labeled "July 1961." July data was actually published in the January 1962 issue.


WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
MINNESOTA
WISCONSIN
SOUTH DAKOTA
WYOMING
NEBRASKA
IOWA
MICHIGAN
NEW YORK
VT.
N.H.
ME.
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CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
TENN.
N. CARO.
S. CARO.
TEXAS
MISS.
ALABAMA
GEORGIA
LA.
FLORIDA

As of November 29, 1961

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

Strontium-90 In Tap Water

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Health and Safety Laboratory performs analyses for strontium-90 concentrations in tap water for Richmond, California, and New York City on a monthly basis. Table 1 presents the data for the second quarter of 1961 as well as the 1959 and 1960 averages. Figure 1 graphically presents this data.

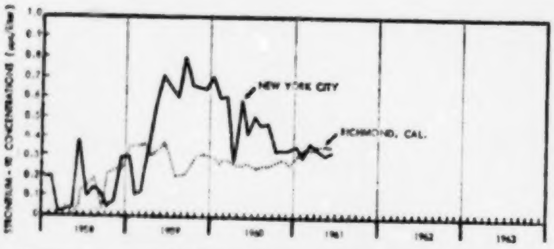

FIGURE 1.—STRONTIUM-90 CONCENTRATIONS IN TAP WATER

Previous data have been presented in earlier issues of *Radiological Health Data*. Future issues will include results of strontium-89 analyses which began with the September 1961 samples.

TABLE 1.—STRONTIUM-90 IN TAP WATER, SECOND QUARTER 1961[1]

Location	Period	Average concentration (μμc/liter)
Richmond, California (40 liters per sample)	1959 1960 January–June 1961	0.29 0.26 0.33
	April 1961 May 1961 June 1961	0.35 0.35 0.35
New York City (100-200 liter per sample)	1959 1960 January–June 1961	0.40 0.47 0.34
	April 1961 May June	0.34 0.32 0.33

[1] Data from *Quarterly Summary Report, HASL*–117, December 30, 1961.

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SECTION V.—OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise, but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, DECEMBER 1961

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Lawrence	Mass	0.02
Anchorage	Alaska	0.01	Lansing	Mich	0.02
Attu	Alaska	0.01	Minneapolis	Minn	0.01
Cold Bay	Alaska	0.01	Jackson	Miss	0.01
Fairbanks	Alaska	0.01	Pascagoula	Miss	0.02
Juneau	Alaska	0.01	Jefferson City	Mo	0.01
Kodiak	Alaska	0.01	Helena	Mont	0.03
Nome	Alaska	0.01	Lincoln	Nebr	0.01
Point Barrow	Alaska	0.01	Trenton	N. J	0.02
St. Paul Island	Alaska	0.02	Santa Fe	N. Mex	0.03
Phoenix	Ariz	0.02	Albany	N. Y	0.02
Little Rock	Ark	0.01	Gastonia	N. C	0.02
Berkeley	Calif	0.02	Bismarck	N. Dak	0.01
Denver	Colo	0.02	Columbus	Ohio	0.01
Hartford	Conn	0.01	Oklahoma City	Okla	0.02
Washington	D. C	0.02	Ponca City	Okla	0.04
Jacksonville	Fla	0.01	Portland	Oreg	0.02
Miami	Fla	0.01	Harrisburg	Pa	0.01
Atlanta	Ga	0.03	Providence	R. I	0.02
Agana	Guam	0.01	Columbia	S. C	0.02
Honolulu	Hawaii	0.03	Pierre	S. Dak	0.02
Boise	Idaho	0.02	Nashville	Tenn	0.01
Springfield	Ill	0.01	Austin	Tex	0.01
Indianapolis	Ind	0.01	El Paso	Tex	0.02
Iowa City	Iowa	0.03	Salt Lake City	Utah	0.02
Topeka	Kans	0.02	Richmond	Va	0.02
Frankfort	Ky	0.01	Seattle	Wash	0.01
New Orleans	La	0.02	Madison	Wis	0.02
Augusta	Maine	0.02	Cheyenne	Wyo	0.02
Baltimore	Md	0.02			

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Direct Measurements of Fallout Gamma Dose in Sweden and New York City[1]

J. H. Harley, Health and Safety Laboratory
U.S. Atomic Energy Commission

There have been few measurements of the gamma dose rate or gamma dose resulting from weapons test fallout. In general, the levels are too low to obtain meaningful results with the usual instruments. Efforts have been made following the recent USSR test series to measure the dose rate or dose.

Some measurements made by the Radiophysical Institute in Sweden have been made available by Dr. T. Magnusson of the Swedish Institute for National Defense. These measurements are made with integrating chambers and are measured over a one-half week period. The results of these are given in table 1.

Since the middle of September, a series of measurements have also been made on the HASL roof with a portable gamma scintillation detector. These are instantaneous dose rates, however, and the subtraction of background is subject to greater statistical error. Possible increases of about 0.001 mr/hr have been noted during November 1–3, 20–22, and 27–29.

Another estimation was made by calculating the expected gamma dose rate from the measurement of total beta activity on gummed film. The gamma estimates are given in table 2. It should be noted that the gummed film estimates represent only the 24-hour fallout contribution and are not cumulative. Thus they are only indicative that the low direct gamma readings are not unexpected.

While no simple direct comparison can be made, it is apparent that the current doses from fallout in New York City are lower than those found in Sweden. This is to be expected geographically.

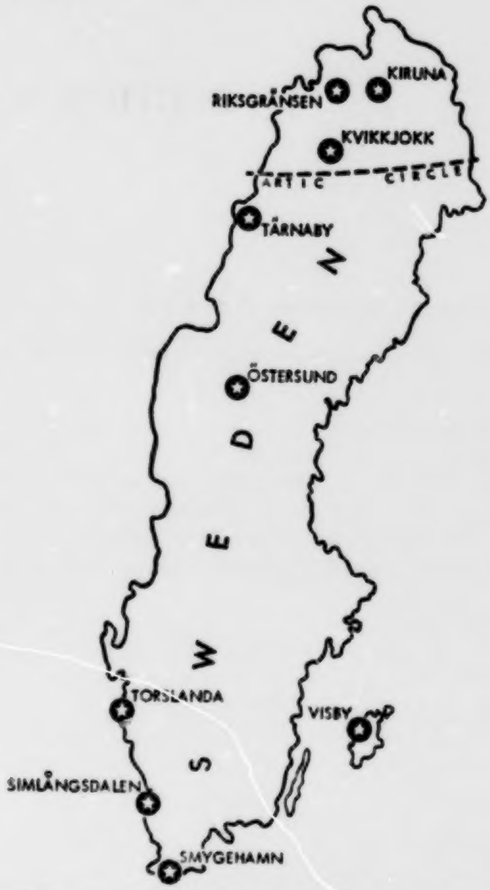

FIGURE 1.—GAMMA DOSE MEASUREMENT LOCATIONS IN SWEDEN

TABLE 1.—GAMMA DOSE FROM FALLOUT MEASURED IN SWEDEN, 1961

[mr/hr—3½-day averages]

Location	October						November			
	9-13	13-16	16-20	20-23	23-27	27-30	30-3	3-6	6-10	10-13
Riksgransen	0.0042	0.0038	0.0023	0.0018	0.0018	0.0018	S*	S	S	S
Kiruna	0.0014	0.0010	0.0018	0.0013	0.0013	0.0014	S	S	S	S
Kvikkjokk	0.0006	<0.0006	0.0008	<0.0006	0.0011	0.0010	S	S	S	S
Tarnaby	0.0006	<0.0006	0.0008	0.0007	0.0010	0.0011	0.0008	0.0007	0.0008	0.0013
Ostersund	<0.0006	<0.0006	0.0008	0.0007	0.0008	0.0007	0.0010	0.0007	0.0010	0.0008
Visby	<0.0006	<0.0006	0.0017	0.0008	0.0006	0.0010	0.0011	0.0006	0.0008	0.0015
Torslanda	0.0006	<0.0006	0.0008	0.0008	0.0005	0.0006	0.0011	0.0015	0.0015	0.0015
Simlangsdalen	—	—	—	—	0.0012	0.0012	0.0012	0.0007	0.0006	0.0014
Smygehamn	—	—	—	—	0.0011	0.0010	0.0010	0.0010	0.0012	0.0011

* Snow cover, no measurements made.

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[1] Taken from *Quarterly Summary Report, HASL–117*, December 30, 1961.

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TABLE 2.—ESTIMATE OF GAMMA DOSE RATE CALCULATED FROM GUMMED FILM AT NEW YORK CITY, 1961

[Only dose rates of 0.0001 mr/hour or greater are shown]

Date	Gamma dose rate (mr/hour)	Date	Gamma dose rate (mr/hour)
September 17	0.0003	October 21	0.0001
18	0.0001	22	0.0004
19	0.0002	November 7	0.0001
21	0.0001	13	0.0001
29	0.0006	14	0.0002
October 3	0.0001	16	0.0002
14	0.0001	17	0.0003
15	0.0002	20	0.0003
16	0.0001	24	0.0003

Strontium-90 in Miscellaneous Biological Samples[1]

Health and Safety Laboratory, U.S. Atomic Energy Commission
Soil Survey Laboratory, U.S. Department of Agriculture

In 1956, the first intensive worldwide sampling for cumulative strontium–90 levels in soils was undertaken by the Health and Safety Laboratory in cooperation with the U.S. Department of Agriculture. At some of the sampling sites, certain biological samples were available that might possibly have been of use as biological indicators of the fallout situation near the collection site. Where these samples were available, they were collected and analyzed for strontium–90 and calcium. No attempt was made to seriously seek biological indicators for a given locale but rather, different kinds of samples were obtained to see qualitatively what the effects of the fallout in the region were on the levels detected in the samples. Since 1956, sampling of miscellaneous biological materials has continued on a very limited basis.

In general, the samples analyzed were animal bones, vegetation, and soil. It was felt that soil levels would indicate the total amount of strontium–90 that had fallen in the given area, vegetation levels would reflect the cumulative deposition as well as the recent deposition of strontium–90, and that the bone levels would indirectly reflect the levels in vegetation and soil. These impressions have since been verified to some extent by the results of the pasture survey in the United States which was conducted concurrently.[1] The sporadic nature of the sampling of the miscellaneous biological materials has made it impossible to come to any firm conclusions as to any further meaning of the results or their implications as far as fallout is concerned. The results are presented in Table 1.

Two sets of samples require some explanations. They are the snowy owl pellets obtained in Barrow, Alaska, from 1956 to 1960 and the moss samples obtained at Ft. Chimo, Quebec, in 1959 and 1960. The snowy owl pellets were collected because the strontium–90 and calcium levels reflect the levels in the bones of lemmings on which the owls fed. The two different kinds of moss sampled in 1959 and 1960 were obtained in connection with soil sampling. The strontium–90 that is deposited on and in the moss may be useful in place of soil measurements in determining the cumulative deposition of strontium–90 at a given site, where perhaps this information could not readily be obtained in any other way.

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[1] *Quarterly Summary Report, HASL–115*, October 1, 1961.

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TABLE 1.—STRONTIUM-90 IN MISCELLANEOUS BIOLOGICAL AND SOIL SAMPLES

Sampling locations	Sample type	Sampling period	Sr^{90} concentration	
			μμc/g Ca	mc/km²
Alaska:				
Barrow	Snowy owl pellets	1956	21	
		1957	[a] 7	
		1958	13	
		1960	53	
	Snowy owl skeletons	1960	20	
	Pomarine jaeger chick skeletons	1960	22	
	Soil	1956	....	1.2
		1958	....	1.5
		1959	....	4.2
		1960	....	3.5
Eagle	Caribou bones:			
	fawn	Oct. 1956	50	
	steer	Dec. 1956	112	
Fairbanks	Soil	1956	....	1.5
		1958	....	4.6
		1959	....	7.3
		1960	....	9.6
Mile-70	Caribou bones: Yearling	Oct. 1958	133	
Palmer	Yearling calf leg bones	Nov. 1956	4	
	Soil	1956	....	2.3
		1958	....	4.2
		1959	....	8.5
		1960	....	10.8
Canada:				
Agassiz, B. C.	Sheep leg bones	Jan. 1957	32	
	Soil	June 1957	....	13.5
		May 1958	....	18.9
		Sept. 1959	....	34.7
		Sept. 1960	....	35.1
Fort Chimo, Quebec	Caribou moss	1959	565	4.2
		Sept. 1960	940	8.1
	Sphagnum moss	1959	226	10.0
		Sept. 1960	25	7.7
	Soil (undisturbed, 0-6 inches)	June 1959	....	4.2
		Sept. 1960	....	5.4
Lacombe, Alberta	Sheep leg bones: 1 year old	1956	26	
	Soil	Aug. 1956	....	3.1
		May 1958	....	9.3
		Sept. 1959	....	15.0
		Aug. 1960	....	17.0
Reindeer Station, Northwest Territories	Reindeer leg bones:			
	9 mo. old fawn	Jan. 1959	85	
	33 mo. old steer	Jan. 1959	92	
	8 mo. old fawn	Nov. 1959	98	
	20 mo. old steer	Dec. 1959	121	
	Soil	July 1957	....	1.9
		July 1959	....	1.9
		July 1960	....	5.0
St. John's, Newfoundland	Sheep leg bones	1956	63	
	9 mo. old	Nov. 1958	128	
	7 mo. old	Sept. 1959	173	
	8 mo. old	Oct. 1960	114	
	Soil	Oct. 1956	....	3.5
		Jan. 1959	....	19.3
		Sept. 1959	....	27.8
		May 1960	....	29.0
Iceland:				
Reykjavik	Lamb leg bone	1960	41	
	Grass	June 1958	864	1.2
	Soil	Aug. 1958	....	12.7
		June 1959	....	24.7
		Oct. 1960	....	23.2
Japan:				
Fukuoka	Soil	Feb. 1958	....	9.6
		June 1959	....	18.5
		Dec. 1960	....	27.4
Hiroshima	Goat leg bone	1956	7	
Nagasaki	Goat leg bone	1956	4.5	
Philippines:				
Manila	Lamb leg bone:			
	5 mo. old	Apr. 1956	2	
	11 mo. old	July 1956	4.5	
	Soil	Apr. 1956	....	2.3
		Feb. 1958	....	2.7
		June 1959	....	5.0
		Dec. 1960	....	6.9

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TABLE 1.—STRONTIUM-90 IN MISCELLANEOUS BIOLOGICAL AND SOIL SAMPLES—Continued

Sampling locations	Sample type	Sampling period	Sr^{90} concentration	
			μμc/g Ca	mc/km²
Puerto Rico:				
Lajas Experiment Station	Goat leg bone:			
	10 mo. old	Dec. 1957	5	
	11 mo. old	Dec. 1958	[illegible]	
	11 mo. old	Dec. 1959	9	
	10 mo. old	Dec. 1960	4	
	Soil	Sept. 1957	…………	6.6
El Younque: (rain forest)	Soil	Sept. 1957	…………	17.0
San Juan	Soil	Nov. 1958	…………	12.4
		July 1959	…………	20.1
Chile:				
Antofagasta	Cactus	Feb. 1956	1	
	Pepper tree	Feb. 1958	2.5	
	Soil	Jan. 1956	…………	0.04
		Feb. 1958	…………	0.15
		Dec. 1960	…………	0.35
Punta Arenas	Sheep leg bone	Jan. 1956	7	
	Soil	Jan. 1956	…………	0.38
		Mar. 1958	…………	1.9
		Oct. 1959	…………	3.1
		Dec. 1960	…………	2.3
Australia:				
Adelaide	Sheep leg bone, 1 yr. old	May 1956	2.5	
	Soil	May 1956	…………	1.9
		Mar. 1958	…………	4.6
		June 1959	…………	5.0
		Dec. 1960	…………	5.4
New Zealand:				
Timaru	Sheep leg bone:			
	Farm A	1956	5	
	Farm B	1956	13	
	Soil	Apr. 1956	…………	0.8
		Mar. 1958	…………	3.1
		Sept. 1959	…………	3.9
		Jan. 1961	…………	4.6

[a] Old sample.

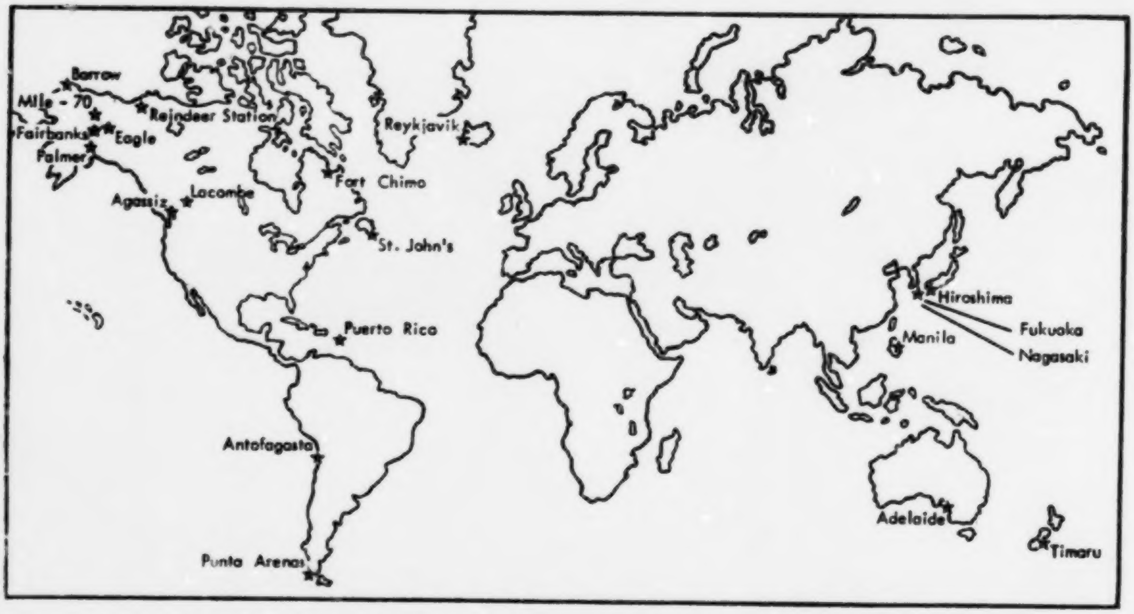
Barrow
Mile - 70
Reindeer Station
Fairbanks
Eagle
Palmer
Reykjavik
Fort Chimo
Agassiz
Lacombe
St. John's
Hiroshima
Fukuoka
Nagasaki
Manila
Puerto Rico
Antofagasta
Adelaide
Timaru
Punta Arenas

FIGURE 1.—SITES FROM WHICH BIOLOGICAL SAMPLES WERE TAKEN

Environmental Monitoring in Alaska

Project Chariot
Atomic Energy Commission

In May 1959, the United States Atomic Energy Commission approved a program of environmental studies to be conducted in conjunction with a proposed excavation project using nuclear explosives (Project Chariot, Plowshare Program) at the mouth of Ogotoruk Creek near Cape Thompson.

The proposed project, which is under study and for which the detonations have not been approved, would involve the simultaneous detonation of five nuclear devices. Four 20-kiloton devices would be buried to about 400 feet and one 200-kiloton device buried to about 800 feet. The detonation of the four smaller devices would be expected to produce a channel about 900 feet wide and 2,000 feet long, with a basin about 1800 feet in diameter resulting from explosion of the larger device. It is expected that about 95 percent of the fission products will be entrapped underground.

After the USSR resumed testing on September 1, 1961, four fallout monitoring stations were activated at Cape Thompson, Kivalina, Kotzebue and Point Hope, as shown in figure 1.

Table 1 presents the November 1961 data. The September and October 1961 data were presented in the December 1961 and February 1962 *Radiological Health Data.* No water samples were taken during November.

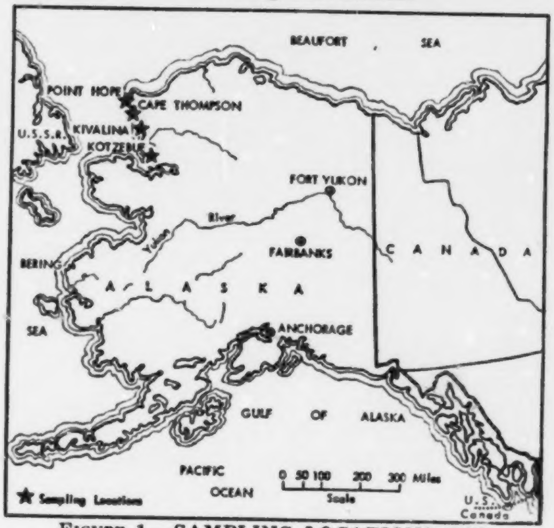

FIGURE 1.—SAMPLING LOCATIONS FOR PROJECT CHARIOT

TABLE 1.—GROSS BETA ACTIVITY IN ALASKAN AIR SAMPLES, NOVEMBER 1961

End of sampling period	Cape Thompson		Kivalina		Kotzebue		Point Hope	
	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)
November 1	[a] —	—	—	—	25.1	3.66	12.0	1.77
2	23.9	2.00	—	—	24.1	1.00	6.3	3.73
3	23.4	3.96	—	—	23.0	3.41	13.8	5.50
4	23.9	5.55	3.3	8.03	25.8	5.85	11.5	3.08
5	23.9	9.62	2.3	7.02	25.8	7.90	13.4	6.34
6	23.8	4.72	—	—	20.6	1.16	8.0	1.41
7	24.2	7.60	—	—	24.3	1.30	4.5	7.33
8	23.9	1.50	—	—	23.3	1.51	14.3	2.60
9	24.2	2.06	—	—	24.0	5.29	14.0	1.49
10	24.2	6.20	—	—	24.0	2.32	12.3	1.93
11	24.0	2.70	—	—	24.5	2.54	10.3	1.29
12	23.9	1.30	—	—	—	—	12.4	3.45
13	24.1	1.95	—	—	47.5	4.23	10.8	3.21
14	24.2	3.33	—	—	24.0	3.96	13.5	2.75
15	23.4	2.49	—	—	24.0	8.55	13.8	3.75
16	22.7	3.68	—	—	24.0	2.27	14.5	2.09
17	24.0	1.09	—	—	—	—	13.8	7.37
18	23.8	5.78	—	—	23.8	3.38	8.3	2.82
19	23.9	1.06	—	—	24.0	9.55	9.4	2.12
20	24.2	8.23	—	—	—	—	10.3	1.13
21	23.9	5.75	—	—	24.2	1.15	12.3	1.14
22	24.2	2.32	—	—	24.1	8.17	13.1	4.57
23	22.2	1.03	—	—	28.2	3.76	13.2	9.35
24	23.8	7.67	—	—	19.8	7.34	13.6	9.27
25	23.2	6.07	—	—	24.8	5.77	10.4	8.07
26	24.7	1.38	—	—	25.8	7.25	12.9	1.17
27	23.6	9.83	—	—	21.6	1.03	12.9	1.03
28	23.7	7.16	—	—	24.0	1.04	13.3	7.26
29			—	—	24.1	7.32		
30			—	—	24.0	8.04		

[a] Dash indicates no sample received.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission submits to the Public Health Service quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November, 1960. Summaries follow for Knolls Atomic Power Laboratory, Lawrence Radiation Laboratory and S1C Prototype Reactor Facility, for the first and second quarters of 1961.

The measured concentration of a radioactive substance in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurements (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic analyses necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's as reported by the respective laboratories.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line No.	Radioactive substance	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	Cerium-144	10,000	200
2	Cesium-137	20,000	500
3	Iodine-131	2,000	300
4	Plutonium-239	5,000	0.06
5	Ruthenium-106	10,000	200
6	Strontium-89	10,000	1,000
7	Strontium-90	100	10
8	Zirconium-95	60,000	1,000
9	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, At^{211}, Ra^{223}, Ra^{224}, Ra^{226}, Ac^{227}, Ra^{228}, Th^{230}, Pa^{231}, Th^{232}, and Th-nat are not present[1]	3,000	—
10	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[1]	600	—
11	If Ra^{226}, Ra^{228} are not present[1]	100	—
12	Mixture of unidentified nuclides	10	0.04
13	If α emitters and Ac^{227} are not present[1]	—	1.0
14	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[1]	—	10
15	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[1]	—	100

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of the concentration of each nuclide to its appropriate MPC is equal to or less than 1/10 and i the sum of these ratios for the group in question is equal to or less than 1/4

Knolls Atomic Power Laboratory

General Electric Company
Schenectady, New York

First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	December 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	September 1961

The Knolls Atomic Power Laboratory (KAPL) has been operated by the General Electric Company for the Atomic Energy Commission since 1946. The principal task of KAPL is to support the Naval Reactors Program of the Commission in the development of atomic power reactors for naval propulsion. This task includes design, construction and prototype operation of nuclear power reactors.

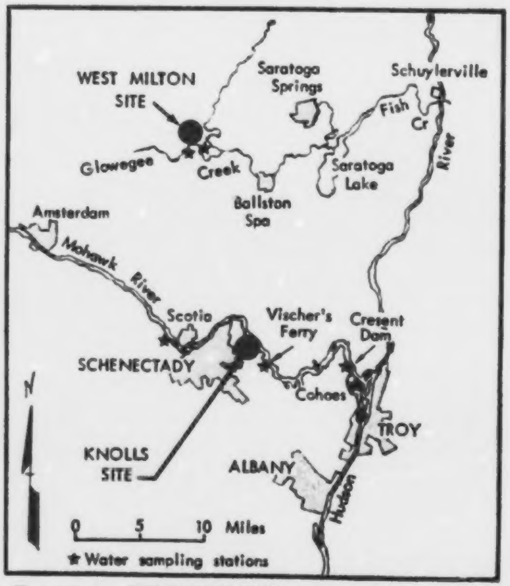

FIGURE 1.—ENVIRONMENTAL MONITORING LOCATIONS, KAPL

The Knolls Atomic Power Laboratory consists of two sites, the Knolls Site and the West Milton Site located as shown in figure 1. The former is located five miles east of Schenectady, New York, on the south bank of the Mohawk River. It occupies approximately 170 acres, upon which are located administrative buildings; chemistry, physics, metallurgical, engineering and radioactive materials laboratories; critical assembly buildings; machine shops; decontamination facilities; radioactive waste storage and processing facilities; and nuclear fuel storage and assembly buildings. The West Milton Site is located approximately 18 miles north of Schenectady, in Saratoga County. It occupies approximately 4,000 acres; principal facilities include the Triton prototype reactor, equipment service building, fuel service building and waste treatment facility. In addition, there are administration and utility service buildings. There is also a containment sphere in which the destroyer prototype reactor now is being constructed.

Air Monitoring

Environmental airborne radioactivity is measured at three locations on the Knolls Site, four locations on the West Milton Site and at the General Electric Company Research Laboratory, approximately one mile west of the Knolls Site. Airborne radioactivity is sampled continuously and analyzed on a weekly basis. The results of the airborne radioactivity analyses are given in table 2. Measurements of airborne radioactivity are made at least 48 hours after collection to allow the naturally occurring short-lived materials to decay.

TABLE 2.—AIRBORNE LONG-LIVED BETA ACTIVITY

[Average concentrations in $\mu\mu c/m^3$]

Sampling locations	First quarter 1961	Second quarter 1961
Knolls site	0.05	0.10
West Milton site	0.07	0.12
Off-site	0.02	0.10

Liquid Waste Monitoring

All potential sources of liquid radioactive waste at the Knolls Site are connected by control drains to collection tanks in the radioactive waste processing building. The release of liquid waste to the Mohawk River is regulated through the control and monitoring of the concentration of fission products in the collection tanks and the control of the discharge rate of the effluent. A continuous proportional sample of the Knolls Site combined sewer effluent is taken at the point of discharge to the Mohawk River. Radiochemical analyses of weekly composite samples show that strontium–90 is the principal component which must be considered in control. The amounts and the radioisotopic content of the combined sewer effluent discharged from the Knolls Site during the first and second quarters of 1961 have been summarized in table 3. A total of 3.814 curies of beta activity were discharged to the Mohawk River during the first and second quarters.

TABLE 3.—RADIONUCLIDE CONCENTRATIONS IN THE KNOLLS SITE WASTE EFFLUENT

[Average concentrations in μμc/liter]

Radionuclide	First quarter 1961	Second quarter 1961
Ce^{144}	6,200	6,700
Sr^{89}	1,600	1,400
Sr^{90}	4,800	6,900
Cs^{137}	5,600	5,800
Ru^{106}	<200	600
Zr^{95}	<200	<230
I^{131}	<200	460
Gross beta	20,000	23,000

Knolls Site effluent is monitored continuously for alpha radioactivity. The quarterly discharge rate was less than one percent of the environmental limit for plutonium–239.

Mohawk River water is sampled at locations upstream and downstream from the Knolls Site. The continuous sample locations are: (1) the General Electric Company Powerhouse eight miles upstream from the Knolls Site, (2) the point of discharge to the Mohawk River from the Knolls Site, and (3) the Vischer Ferry Powerhouse approximately two miles downstream. Samples taken from the City of Cohoes pumping station approximately thirteen miles downstream show about the same concentrations obtained for the Vischer Ferry samples shown in table 4.

TABLE 4.—GROSS BETA ACTIVITY IN STREAMS RECEIVING EFFLUENTS

[Average concentrations in μμc/liter]

Stream and location	First quarter 1961	Second quarter 1961
Mohawk River (Knolls site):		
G. E. Powerhouse (upstream)	4	9
Vischer Ferry (downstream)	5	7
Glowegee Creek (West Milton site):		
Upstream	6	4
Downstream	6	10

Since the Glowegee Creek does not have a reliable dilution potential, the radioactivity levels in the liquid waste from the West Milton Site are operationally controlled and diluted prior to release to the creek. A total of 0.00597 curies were discharged to Glowegee Creek during the first and second quarters at an average concentration of about 200 μμc/liter.

Samples of the Glowegee Creek water are taken once a week at two locations, 150 feet above and 2,640 feet below the point where the West Milton Site effluent enters the creek. Average concentrations found in samples of Glowegee Creek surface water for first and second quarters 1961 are shown in table 4.

Lawrence Radiation Laboratory

Berkeley, California
Fourth Quarter 1960, and First and Second Quarters 1961

In the following report data are given on environmental radiation levels associated with the operation of the Berkeley and Livermore sites of the Lawrence Radiation Laboratory (LRL). This is the initial coverage of LRL in *Radiological Health Data.*

The Berkeley site of LRL is situated on the western slope of the hills to the east of the Berkeley campus of the University of California. Winds are generally westerly; annual rainfall is 23 inches, almost all of which falls between November 1st and May 1st. Technical facilities include a 6.3 Bev proton accelerator, a 700 Mev cyclotron, a linear accelerator of 10 Mev per nucleon, and various chemistry and physics laboratories.

The Livermore site of LRL is located on a 640 acre plot of flat ground, three miles east of the city of Livermore, California. Rainfall is approximately 12 inches per year; winds are normally westerly. Technical facilities include a small cyclotron, a 2-Megawatt swimming pool reactor, and physics and chemistry operations associated with a weapons development program.

The radiation levels given in tables 5 and 8 refer to areas accessible to the general public at the boundaries of the Berkeley and Livermore sites of the Lawrence Radiation Laboratory.

TABLE 5.—AVERAGE CONCENTRATIONS, FOURTH QUARTER 1960

Monitoring	Berkeley site		Livermore site	
	α	β-γ	α	β-γ
Air ($\mu\mu c/m^3$)	0.017	2.1	0.046	0.115
Water ($\mu\mu c$/liter)	<0.2	4	<18	<116
Sewage ($\mu\mu c$/liter	<0.2	<0.6	<18	<116

TABLE 6.—AVERAGE CONCENTRATIONS AT THE BERKELEY SITE

Monitoring	First quarter 1961		Second quarter 1961	
	α	β-γ	α	β-γ
Air, stacks ($\mu\mu c/m^3$)	0.007	0.43	0.152	0.5
Surface water ($\mu\mu c$/liter):				
On-site streams	0.19	4.9	0.10	8.5
Off-site streams	<0.12	<2	0.10	7.1

TABLE 7.—AVERAGE CONCENTRATIONS AT THE LIVERMORE SITES

Monitoring	First quarter 1961		Second quarter 1961	
	α	β-γ	α	β-γ
Air ($\mu\mu c/m^3$):				
Radius 0.5-1.0 miles	0.043	0.25	<0.011	0.055
Radius 2-5 miles	0.038	0.29	<0.011	0.52
Water ($\mu\mu c$/liter):				
In plant well	<18	<116	<18	<116
Livermore public water	<18	<116	<18	<116
Plant effluent	<18	<116	<18	<116

TABLE 8.—EXTERNAL NEUTRON-GAMMA DOSE AT SITE PERIPHERY

[Dose in millirems]

Site	Fourth quarter 1960	First quarter 1961	Second quarter 1961
Berkeley	50	110	127
Livermore	<5	<5	<5

S1C Prototype Reactor Facility

Combustion Engineering, Inc.
Windsor, Connecticut

First and Second Quarters 1961

Previous coverage in *Radiological Health Data:*

Period	*Issue*
First quarter 1960	November 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	September 1961

The S1C Prototype is a land based nuclear submarine power plant facility. This facility is operated for the Atomic Energy Commission by the Naval Reactors Division of Combustion Engineering, Inc. at Windsor Connecticut. The Prototype contains a pressurized water reactor power plant which is used to conduct research and development work and to train personnel in operation of naval reactor power plants. Reactor power operations at the S1C prototype facility began in December 1959.

Essentially all of the radioactive wastes originate from the activation of minute amounts of impurities and corrosion products in the cir-

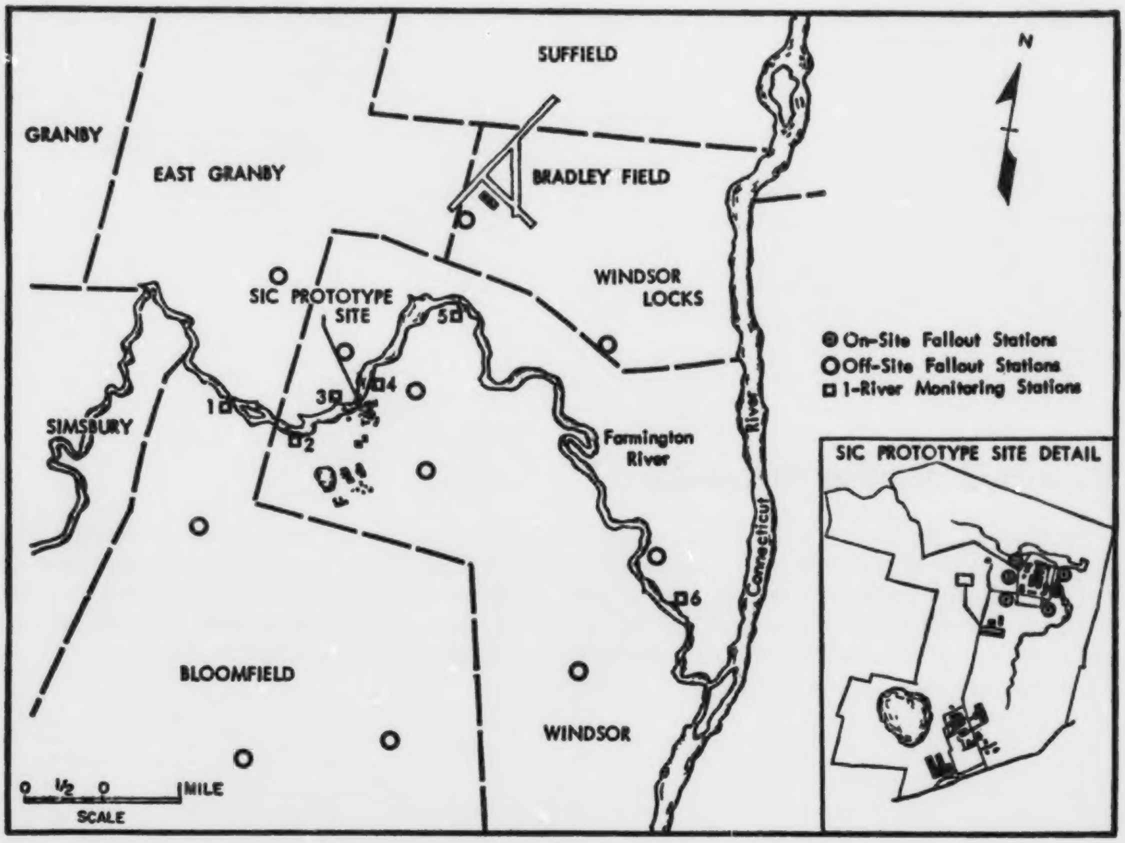
SUFFIELD
N
GRANBY
EAST GRANBY
BRADLEY FIELD
WINDSOR LOCKS
SIC PROTOTYPE SITE
5
● On-Site Fallout Stations
○ Off-Site Fallout Stations
□ 1-River Monitoring Stations
1
3
4
2
SIMSBURY
Farmington River
Connecticut River
SIC PROTOTYPE SITE DETAIL
6
BLOOMFIELD
WINDSOR
0 1/2 0 MILE
SCALE

Figure 1.—ENVIRONMENTAL MONITORING LOCATIONS, S1C PROTOTYPE SITE

culating water used as a reactor coolant. Small quantities of gaseous waste result from the activation of minute amounts of dissolved gases in the coolant water.

Ventilation air from the submarine hull and the supporting facility is continuously monitored at the exhaust stack. Liquid wastes are monitored before discharge to the Farmington River. Tables 9 and 10 give the average beta-gamma concentrations of airborne and liquid wastes before release to the environment.

Figure 2 shows the locations of six water sampling stations along the Farmington River and 17 fallout monitoring stations. Comparing the data for upstream and downstream samples in table 11, and for on-site and off-site fallout samples in table 12, no evidence is seen of radioactivity in the environment contributed by the S1C Facility.

Refer to September 1961 issue of *Radiological Health Data* for a more detailed description of S1C Prototype Reactor Facility and its control measures.

Table 9.—AIRBORNE BETA-GAMMA CONCENTRATIONS

[Average concentrations in $\mu\mu c/m^3$]

Sampling location	First quarter 1961	Second quarter 1961
Stack discharge	55	46
Downward from stack	16	28

Table 10.—GROSS RADIOACTIVITY IN LIQUID WASTES DISCHARGED INTO THE FARMINGTON RIVER

Type of measurement	First quarter 1961	Second quarter 1961
Total for quarter	0.74 mc	2.80 mc
Average concentration	550 $\mu\mu c$/liter	1300 $\mu\mu c$/liter

Table 11.—BETA-GAMMA CONCENTRATIONS IN THE FARMINGTON RIVER

[Average concentrations in μμc/liter]

Sampling location (see figure 2)		First quarter 1961		Second quarter 1961	
		Number of samples	β-γ	Number of samples	β-γ
Upstream.	1	1	9.5	7	4.3
	2	1	8.7	4	8.2
Outlet:	3	1	9.[illegible]	3	2.2
Downstream:	4	1	<1.0	3	4.0
	5	1	2.7	3	1.5
	6	1	5.5	3	5.5

Table 12.—BETA ACTIVITY IN FALLOUT

[Average deposition rate in mc/km² per month]

Sampling locations	First quarter 1961		Second quarter 1961	
	Number of samples	Deposition rate	Number of samples	Deposition rate
On-site (6 stns)	17	0.234	62	0.425
Off-site (11 stns)	37	0.556	43	0.410

Reported Nuclear Detonation

Radiological Health Data, Volume II, Numbers 10, 11, and 12, and Volume III, Numbers 1 and 2, published dates of the Union of Soviet Socialist Republics and the United States announced nuclear detonations through January 31, 1962. The following table gives information on the subsequent tests reported through February 28, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton yield); low-intermediate to mean between a nominal and one megaton yield.

Test number	Location	Date	Size	Type of test
		REPORTED U.S.S.R. DETONATIONS		
32	Semipalatinsk	February 2, 1962	Detectable—unknown	Underground
		REPORTED U.S. DETONATIONS		
13	Nevada Test Site	February 8, 1962	Low yield	Underground
14	Nevada Test Site	February 9, 1962	Low yield	Underground
15	Nevada Test Site	February 15, 1962	Low yield	Underground
16	Nevada Test Site	February 19, 1962	Low yield	Underground
17	Nevada Test Site	February 19, 1962	Low yield	Underground
18	Nevada Test Site	February 23, 1962	Low yield	Underground
19	Nevada Test Site	February 24, 1962	Low yield	Underground